# The Economic Effects of *Pfiesteria* in the Mid-Atlantic Region

Timothy C. Haab, Ohio State University
John C. Whitehead, University of North Carolina at Wilmington
George R. Parsons, University of Delaware
James Kirkley, Virginia Institute of Marine Science
Doug Lipton, University of Maryland

With Contributions by Ash Morgan, University of Delaware;
Isaac Kwakye and Emily Boyd, East Carolina University

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# Executive Summary

In 1992 researchers at North Carolina State University identified Pfiesteria Piscicida (Pfiesteria) as one possible cause of fish kills in eastern North Carolina's estuary system (Burkholder et al.). Pfiesteria is a single-celled microorganism that lies dormant in the sediment of fresh and brackish water estuaries, but in combination with high nutrient concentrations potentially becomes a toxic predator of a number of local fish species (see Appendix A for a literature review). Recently, Pfiesteria has been linked to fish kills in Virginia, Maryland and Delaware. In addition to the scientific questions concerning the effects of Pfiesteria on the ecological health of the Mid-Atlantic region's estuary system, public perception of Pfiesteria and other harmful algal blooms has the potential to impose significant economic losses on the region. Lost use of recreational resources, lost tourism revenues, decreased consumption of seafood, lost fishing time due to estuary closures, possible medical costs for treatment and increased regulation on industries that impact the estuary systems all represent decreases in the economic welfare to the Mid-Atlantic region.

This report summarizes a Mid-Atlantic (North Carolina, Virginia, Maryland and Delaware) study of seafood consumption combining both revealed and contingent behavior questions. As the available economic impact studies show, the seafood industry has been significantly impacted by recent Pfiesteria outbreaks in Maryland and North Carolina. Popular media coverage of Pfiesteria outbreaks has lead to substantial decreases in seafood purchases despite lack of scientific evidence linking these outbreaks to human illness. Because, at the time of this study, the scientific links between Pfiesteria and human health effects are not fully understood, the changes in behavior from outbreaks are driven by the information conveyed to the consumers through the popular media and word of mouth. As such, this study provides a better understanding of how consumers in the mid-Atlantic region respond to negative information about the risks associated with seafood consumption and what types of counter-information can be successful in alleviating the uncertainty associated with these risks.

The study was conducted using a phone-mail-phone survey of approximately 1,800 seafood consumers in North Carolina, Virginia, Maryland, Delaware and Washington, D.C. The initial phone survey elicits attitudinal and knowledge data about Pfiesteria and seafood safety from seafood consumers. The perceived qualitative and quantitative risks of seafood consumptions are also elicited along with a baseline measure of seafood consumption. The mail portion of the survey consists of a split sample information treatment that includes some or all of the following: An informational brochure about the current state of knowledge regarding Pfiesteria and seafood safety, counter information informing consumers that seafood is safe, a press-release of a hypothetical Pfiesteria-related fish kill, and a description of a hypothetical mandatory seafood inspection and certification program. The second phone-survey elicits perceived qualitative and quantitive seafood risk perceptions and seafood consumption both before and after implementation of the seafood inspection program. A contingent valuation exercise is also included to assess consumer willingness to pay for the seafood inspection program.

The phone-mail-phone survey was followed by a series of in-person surveys and de-briefing session to assess the efficacy of the survey instrument.

The report contains:

- A description of the relevant economic theory
- A full description of the survey design process and survey instruments
- Descriptive analysis of the resulting data
- Empirical analyses of the determinant of qualitative and quantitative seafood risk perceptions and the effects of the split-sample information treatments on these assessments
- Analysis of the determinants of the demand for seafood including the effects of the information treatments on seafood demand, the economic welfare effects of Pfiesteria related fish kills and the welfare effects of various information treatments
- Analysis of the willingness to pay for a mandatory seafood inspection program
- Descriptive analysis of the in-person follow-up surveys.

The conclusions of the report are summarized as follows:

- *Reports of Pfiesteria-related fish kills result in adverse reactions on the part of seafood consumers*. Obviously this is not a surprising result, but the prevalence of the result across qualitative seafood risk assessments, quantitative seafood risk assessments and reported demand for seafood leads to the conclusion that this result is robust. Further, the robustness of this result provides a reliability and validity check for the survey instrument utilized (Chapter 3) and the subsequent analysis.

- *The relative size of Pfiesteria-related fish kill events has little impact on the risk perceptions or seafood consumption.* The magnitude of the reported fish kill (as distinguished by a major and minor fish kill) is an insignificant determinant in consumers qualitative assessments of seafood risks, quantitative assessments of risk perceptions, seafood demand or willingness to pay for a seafood inspection program. This result is supported by in-person interviews that indicate that half of respondents receiving the smaller fish kill perceived it as a major event. A number of explanations exist for this result, including, a relatively small range of fish kills offered to individuals in the design of the survey, and individuals interpreted both fish kill scenarios as major events.

- *Simple information conveyance mechanisms, in the form of educational brochures sent to seafood consumers, have mixed effects in reducing the economic consequences of reports of Pfiesteria-related fish kill.* The Pfiesteria brochure sent to consumers was designed to be educational, but not influential. The brochure informed individuals on the current state of knowledge regarding the effects of Pfiesteria and the effects on human health and seafood safety. The Pfiesteria brochure is moderately effective in reducing perceived risk using qualitative assessments of perceived risk, but actually increased the perceived risk in quantitative assessments. These countervailing results are surprising and need further study. The Pfiesteria brochure has no effect on the stated changes in the demand for seafood, but increases the consumer willingness to pay for a mandatory seafood inspection and certification program. This increase in willingness to pay indicates that consumers had a significant adverse reaction to the educational brochure. This conclusion is supported by a series of in-person interviews that found that 43% of respondents found seafood to be less safe after viewing the brochure. Given these mixed results, we conclude that simply informing consumers of the current state of thinking regarding Pfiesteria is an ineffective mechanism for reducing the economic impacts of Pfiesteria–related fish kills.

- *Counter-information treatments designed to alleviate misperceptions associated with Pfiesteria related fish-kills have moderate to no effects on the adverse (seafood related) economic effects of a fish-kill.* Counter information treatments that state that seafood is safe as long as it is handled properly and no visible signs of inspection are present are effective in reducing the perceived risks of seafood as measured qualitatively for North Carolina residents, but ineffective for Maryland, Delaware and Washington, D.C. residents. The counter-information has no significant effect on the quantitative risk perception, or the reported demand for seafood, but consumers indicate a decreased willingness to pay for a mandatory seafood inspection program after viewing the counter-information indicating a partial reduction in the perceived risk of seafood.

- *A mandatory seafood inspection program is an effective mechanism for alleviating the economic losses associated with a publicized Pfiesteria-related fish kill.* A hypothetical mandatory seafood inspection program proves to be a robust tool for eliminating the perceived increase in the qualitative risk of seafood associated with a fish-kill, the increase in quantitative risk of seafood associated with a fish-kill, and the reduced demand for seafood. The results of a contingent valuation exercise find that consumers are willing to absorb (on average) a 100% increase in the price of a seafood meal to ensure that the seafood is inspected.

- *The economic effects of a Pfiesteria-related fish-kill are significant.* This report demonstrates that the direct economic effects (in the form of reduced seafood consumption) and indirect effects (in the form of increased perceived risks) of Pfiesteria-related fish kills are substantial. The lost consumer surplus due to a published/reported fish kill is estimated to be between $1.70 and $3.31 per meal if no information, counter information or seafood inspection program is provided to the consumer. Aggregating this number to the population of seafood consumers (13.08 million residents, of which 41.6% seafood consumers eat 4 meals per month on average), the lost consumer surplus due to a fish kill event is $37 million to $72 million in the month following the fish kill. Further evidence of the significance of the lost welfare due to uncertainty regarding the safety of seafood is the respondents' stated willingness to pay of $10.76 per meal for a mandatory seafood inspection and certification program, or $2.8 billion annually. The estimated welfare improvements derived from the seafood inspection program are broader in scope that Pfiesteria-related fish-kill events. This figure is significantly higher than the estimated welfare losses associated with a fish kill, and represents a willingness to pay estimate for general seafood safety. This includes uncertainty about safety in relation to Pfiesteria, and other safety concerns.

## Table of Contents

# Chapter 1. Introduction and Overview

## The Problem

In 1992 researchers at North Carolina State University identified Pfiesteria Piscicida (Pfiesteria) as one possible cause of fish kills in eastern North Carolina's estuary system (Burkholder et al.). Pfiesteria is a single-celled microorganism that lies dormant in the sediment of fresh and brackish water estuaries, but in combination with high nutrient concentrations potentially becomes a toxic predator of a number of local fish species (see Appendix A for a literature review). Recently, Pfiesteria has been linked to fish kills in Virginia, Maryland and Delaware. In addition to the scientific questions concerning the effects of Pfiesteria on the ecological health of the Mid-Atlantic region's estuary system, public perception of Pfiesteria and other harmful algal blooms has the potential to impose significant economic losses on the region. Lost use of recreational resources, lost tourism revenues, decreased consumption of seafood, lost fishing time due to estuary closures, possible medical costs for treatment and increased regulation on industries that impact the estuary systems all represent decreases in the economic welfare to the Mid-Atlantic region.

While significant amounts of research are currently being conducted to assess the biological, ecological and environmental effects of Pfiesteria and other harmful algal blooms (HABs), very little work has been conducted to look at the economic impacts or lost benefits due to Pfiesteria outbreaks or HABs. Diaby (1996) estimates a 36% decrease in raw fish purchases from Neuse River (NC) commercial fishermen in 1995 due to Pfiesteria related river closures. However, Diaby was unable to find a significant change in total landings by commercial fishers suggesting fishers were able to easily substitute fish from unaffected areas. In a study looking at the economic impacts of a Pfiesteria outbreak in Maryland in 1997, Lipton (1998) estimates $43 million in lost seafood sales due to public concern over seafood safety. Lipton's study indicates that concern over harmful algal blooms and, in particular, Pfiesteria can lead to a significant decrease in demand for seafood in affected areas, despite a lack of scientific evidence linking any illness from seafood consumption to Pfiesteria. This decrease in demand due to the perceived risk of seafood consumption may result in significant welfare losses to consumers and producers of seafood. Similarly, very few studies have been conducted to look at the economic costs of harmful algal blooms (Jensen, 1975; Kahn and Rockel, 1988; Todd, 1995).

A recent planning meeting sponsored by the Mid-Atlantic Sea Grant (Adams et al.) identified five research priorities for assessing the economic issues associated with Pfiesteria and other harmful algal blooms. These priorities are:

- Measuring the benefits and costs of measures that may either prevent or mitigate the impact of harmful algal blooms.
- Measuring the benefits of improved predictive capability for harmful algal blooms and Pfiesteria-like events, including the costs of prediction error.

- Measuring lost net benefits (as opposed to economic impacts) for determining compensation and similar actions.
- Understanding the "halo effect," the indirect effect that negative publicity related to Pfiesteria and HABs has on products or activities that are not physically impacted by the event. How is the scale and scope of the "halo effect" impacted by the nature of the negative event and the type and extent of information given to the public from both media and public officials?
- The role of different sources and kinds of information on the magnitude of the economic response to a negative event. How does the public respond to counter-information, advertising and educational activities?

The Mid-Atlantic Sea Grant planning report (Adams et al.) advocates the use of combined revealed and contingent behavior studies to assess the economic impacts of Pfiesteria and other HABs. Revealed behavior studies allow the researcher to collect information on actual market or nonmarket transactions carried out by individuals. This revealed behavior information can then be used as a baseline for introducing hypothetical or contingent scenarios to the consumer and measuring the potential changes in economic behavior. For example, how would seafood purchases change if a Pfiesteria outbreak occurs in a geographically remote estuary in Virginia? How long will the change in seafood consumption last? What other markets might be affected? What other behavioral response might be observed (e.g. decreases water-based recreation)?

The combined revealed/contingent behavior approach has the advantage of being tied to actual revealed behavior while not requiring after the fact (ex post) evaluation of changes in behavior from an outbreak. Ex post analysis of an event may lead to recall bias of behavior prior to the event from changes in public perception of the risks after the event has occurred. The revealed/contingent behavior method allows the researcher to use current behavior as the baseline and then control the outbreak and risk information conveyed to the consumer to get a better understanding of how consumers react to the risks and perceptions associated with an outbreak. Understanding the role of public perception of the risks associated with Pfiesteria and HABs, and the potential changes in economic behavior due to increased counter information, or better understanding of the current state of scientific knowledge is fundamental to the design of education campaigns, policies, and regulations to address the problems associated with Pfiesteria and HABs.

This report summarizes a Mid-Atlantic (North Carolina, Virginia, Maryland and Delaware) study of seafood consumption combining both revealed and contingent behavior questions. As the available economic impact studies show, the seafood industry has been significantly impacted by recent Pfiesteria outbreaks in Maryland and North Carolina (Lipton, Diaby). Popular media coverage of Pfiesteria outbreaks has lead to substantial decreases in seafood purchases despite lack of scientific evidence linking these outbreaks to human illness. Lipton also documents a significant decrease in recreational activity (e.g., fishing and water sports) in affected waters. Because the scientific links between Pfiesteria and human health effects are not fully understood, the changes in behavior from outbreaks are driven by the information conveyed to the consumers through the popular media and word of mouth. As such, this study provides a better understanding of how consumers in the mid-Atlantic region respond to negative information about the risks associated with seafood consumption and what types of counter-information can be successful in alleviating the uncertainty associated with these risks.

Literature on Information Conveyance and Risk

The recent literature on food safety suggests that the conveyance of information does affect perceptions and behavior. Two recent studies investigating revealed behavior reactions to media coverage in food markets find that information about increased risk tends to decrease consumption, while counter-information does not necessarily have the opposite effect. Smith, van Ravenswaay, and Thompson (1988) find that negative media coverage of a ban and recall of milk in Hawaii significantly decreased milk consumption but counter-information about safe milk did not significantly increase consumption. Brown and Schrader (1990) find that an index of cholesterol information using medical journal article pages has a consistently negative effect on egg consumption. They find that as egg prices fell and incomes rose, consumption increased less than if there had been no information.

In research related to the conveyance of risk information through survey instruments, Viscusi, Magat, and Huber (1986) present risk information in the form of alternative labeling formats and the size of the warning area for nonfood products (bleach and drain openers). They find that the amount of risk information and the level of risk have predictable effects on the amount of precautions consumers take to protect their health. Smith and Johnson (1988) find that a radon information program, presented with an information pamphlet, had a measurable effect on the effect of perceived radon risk on health. However, the information contained in the pamphlet did not cause perceived and objective measures of risk to converge. Lin and Milon (1993) find that safety perceptions were not important in either shellfish participation or consumption decisions. Responses to new health information, in the form of a television special program that aired during the survey period, were most important in affecting the amount of shellfish consumed, not whether the respondent would participate in the market.

One conclusion that can be drawn from this research, and is directly applicable to an understanding of how consumers react to Pfiesteria and HABs, is that information about risk will alter behavior and consumers tend to self-protect against risk. However, the degree of self-protection will depend on the risk communication instruments. For instance, negative information might lead to consumers dropping out of markets completely while counter-information about the risk of use of products that have had problems in the past may not have similar positive effects. Also, the separation of consumer demand into two consumer decisions may be important when understanding the effect of risk communication on behavior. The first type of behavior is whether or not to be in the market for the good that is risky. The second decision is that once in the market, the amount of the good that will be consumed.

Little comparative research has been conducted pertaining to the effect of alternative risk communication methods on seafood consumption behavior. In related research, Smith and Desvousges (1990) compare four versions of an information booklet, a brochure, and a one-page information fact sheet to communicate information about radon risk. They find that the one-page fact sheet is an inadequate method of communicating risk, relative to the methods that contain more information. In follow up research, Smith and Desvousges (1988) present preliminary results that show that through panel surveys, information can be used by consumers to update their risk perceptions. Loomis and duVair (1993) compare two graphical risk communication devices: the risk ladder and the risk circle. The two risk communication instruments yield different results with the risk ladder yielding larger willingness to pay estimates.

In the food safety contingent behavior literature, Eom (1994) presents risk information using labels explaining two types of produce, those grown with pesticides and those screened for pesticide residues. The size of the risk change is varied from respondent to respondent. Risk perceptions are elicited with a Likert scale variable concerning the perceived health risks from consuming the unscreened produce. Buzby, Ready, and Skees (1995) present risk information, in the form of a comparison between a safe and unsafe pesticides using a risk ladder similar to that of Loomis and duVair (1993). Risk perceptions are obtained through Likert scale attitudinal questions. Hayes et al. (1995) present risk information using probabilities of becoming ill from various pathogens. Risk perceptions are then obtained with an open-ended survey question.

This review of the contingent behavior literature reveals that there is little agreement on how best to elicit risk perceptions and present risk information to the public. Comparative risk communication research is needed in application to food safety issues.

The economic theory of consumer behavior under uncertainty provides a framework to understand the links between risk communication, perceptions, and behavioral intentions. State-dependent expected utility theory (Cook and Graham, 1977) and prospective reference theory (Viscusi, 1989) is used to model the process of risk perceptions and economic value. Prospective reference theory will be used to describe how consumers might over or under-estimate seafood safety risk from Pfiesteria.

Previous contingent behavior research has led to a significant amount of knowledge about consumer behavior under risk from pesticide residues. van Ravenswaay (1995) reviews some of the early research on willingness to pay for reduced pesticide residue risks and concludes that risk perceptions are not the only predictors of willingness to pay and that people are intolerant of even very low risks. In a study of Alar and apples, consumers were found to be willing to pay almost 33% more per pound of apples that were tested and certified to either have no pesticide residues above federal limits or to have no detectable pesticides. Respondents were willing to pay almost 50% more per pound of apples that were tested and certified to have no pesticide residues. Risk perceptions were a significant predictor of willingness to pay but those who perceived especially high risks were not willing to pay a significant premium.

Eom (1994) uses prospective reference theory to link risk information, perception, and valuation in a paired comparison, discrete choice willingness to pay framework and finds that consumers are willing to pay higher prices for safe produce, even if the risk reduction is small. Also, technical risk information has only small effects on willingness to pay except when the information is interacted with perceptions about risk. Hayes et al. (1995) find that respondents underestimate the low probabilities of food-borne illness. Willingness to pay does not vary over a large range of risk reductions suggesting that respondents do not respond to risk information, instead relying on prior risk perceptions. Buzby, Ready, and Skees (1995) find willingness to pay for pesticide free grapefruit fell with age and income. These results are explained by recognizing that older respondents are less risk averse to food safety. Also, higher income respondents may be less concerned about food safety because they have access to better information.

The Current Study

In the present study, a contingent behavior survey is used to assess the economic value revealed by behavioral intentions towards seafood consumption under various risk and policy scenarios. Viscusi (1993) reviews applications of the revealed and contingent behavior methods to the valuation of health and safety and emphasizes the usefulness of contingent behavior methods in being able to evaluate risk reductions beyond the observed, or historical, range of risk. In the case of Pfiesteria and HABs in the Mid-Atlantic region, the contingent behavior method alleviates the need for ex post analysis of an outbreak. By carefully developing realistic scenarios about Pfiesteria outbreaks, and conveying that information to potential seafood consumers we are able to measure the potential effects of an outbreak without actually observing one.

By combining revealed behavior regarding seafood consumption with contingent behavior regarding future seafood consumption plans under a variety of realistic hypothetical outbreak and policy scenarios, we address each of the research priorities outlined in the aforementioned planning report.

Outline of this Report

This report is outlined as follows. Chapter 2 contains a description of the economic theory necessary for modeling consumer risk perceptions as they relate to Pfiesteria, and the theory needed to estimate the economic welfare effects of Pfiesteria outbreaks. The theory is also used to guide the survey design.

Chapters 3 and 4 describe the details of the survey instrument and implementation, and provide basic descriptive results for the primary survey. Chapter 3 contains a description of the full survey as implemented. Detailed descriptions of the telephone-mail-telephone survey, along with details of survey development, focus groups and pre-testing are included. The survey instruments and supplementary material are included in the appendices. The survey responses are summarized in Chapter 4. The data summary includes details of the sampling frame, response rates, and demographics.

Descriptive statistics are summarized by state, and region. Details of response rates for each phase of the survey as well as analysis of attrition rates over the three survey phases are reported.

Chapters 5 through 10 present detailed analyses of survey responses. Chapter 5 contains an analysis of the perceptions of seafood safety and risks from eating seafood. Qualitative responses to knowledge of Pfiesteria and seafood safety are discussed. Models are estimated to relate seafood safety and Pfiesteria perceptions to demographic variables and various information and counter-information treatments. Chapter 6 quantifies risk perceptions based on seafood consumers' responses to perceived risk questions. Models are estimated to relate these quantified risks to individual demographics, and information treatments. The effects of information and counter-information treatments on quantified risks are estimated. It is shown that negative information (in the form of a Pfiesteria outbreak) has a significant negative impact on the perceived risk of seafood consumption, and actions regarding seafood safety (in the form of stronger seafood inspection programs) will more likely alleviate fears than simple counter-information strategies.

Chapter 7 estimates models of seafood demand as a function of the information treatments. Chapter 8 estimates consumer willingness to pay for a seafood inspection program using the contingent valuation method. Chapter 9 reports the results of a separate in-person survey to assess risk perceptions and seafood demand in the presence of Pfiesteria outbreaks using a survey instrument similar to the phone-mail-phone instrument of the main study. Chapter 10 concludes the report.

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# Chapter 2. Theory of Perceived Risk, Seafood Consumption, and Economic Welfare

In this chapter we develop the economic theory used to guide survey design and define the economic effects of Pfiesteria-related fish kills and other changes in seafood safety. We conceptualize Pfiesteria as a factor affecting perceptions of seafood safety that affects perceived health risk. Consumer seafood demand is a function of perceived health risk. Once the seafood demand functions are derived, we develop the concept of consumer surplus and willingness to pay for risk change.

## The Model

Consider the utility, *u*, of a seafood consumer

$$u = u(x, h, z) \quad (2.1)$$
$$where: \quad \frac{\partial u}{\partial x} > 0, \frac{\partial^2 u}{\partial x^2} < 0, \frac{\partial u}{\partial h} > 0, \frac{\partial u}{\partial z} > 0$$

where *u(.)* is the utility function, *x* is the quantity of seafood meals, *h* is health, and *z* is a composite commodity of all other goods. Utility is increasing in meals at a decreasing rate. Utility is increasing in health and the composite commodity.

Seafood meals are differentiated by quality, *q*,

$$x = x(q) \quad (2.2)$$
$$where: \quad \frac{\partial x}{\partial q} > 0$$

Seafood consumption is increasing in quality that incorporates grades of seafood and consumer perceptions about quality (tastes).

Health is produced according to a production function that includes averting, *a*, and defensive, *d*, behaviors as inputs

$$h = h(a, d) \quad (2.3)$$
$$where: \quad \frac{\partial h}{\partial a} > 0, \frac{\partial h}{\partial d} > 0.$$

In the context of seafood safety, averting behaviors might include preparing and cooking seafood properly. The type of averting behavior that we address is the reduction in seafood consumption when faced with negative information about seafood safety. Defensive behaviors include activities such as trips to the doctor after a seafood-related illness.

The perceived health risk from eating seafood is the subjective probability of getting sick from seafood meals, *r*,

$$r = r(s) \qquad (2.4)$$
$$where: \quad \frac{\partial r}{\partial s} < 0$$

where *s* is a vector of *S* perceived seafood safety variables, $s = s(s_1,...,s_S)$ . Safety is the degree to which seafood consumption can lead to diminished health. Raw seafood (e.g., oysters) is less safe than cooked. Fish obtained from polluted waters is less safe. Diseased fish is less safe. The effect of seafood safety on health risk is negative. Any information that leads to a decrease in perceived seafood safety, such as fish kills and inadequacies associated with government seafood inspection problems, will lead to increased risk. Note that the consumption of seafood leads to a positive probability of getting sick and may also be included in the s vector. Therefore, the perceived health risk is increasing in the number of seafood meals if seafood is considered risky.

Define $h^o$ as (current) healthy and $h'$ as unhealthy (sick) states of the world. The *ex ante* utility function is

$$\tilde{u} = r(s)\cdot u(x,h',z) + (1 - r(s))\cdot u(x,h^o,z). \qquad (2.5)$$

The consumer faces the budget constraint

$$y = px + mh + z \qquad (2.6)$$

where *p* is the price of seafood, *m* is the full cost of health, and the price of the composite commodity is normalized at one, $p_z=1$. The full cost of health depends on costs of averting and defensive behavior. We assume the full cost of health to be constant. Note that *p(q)* is the quality differentiated price of seafood, $\frac{\partial p}{\partial q} > 0$ .

<u>Optimization</u>

The consumer's problem is to minimize expenditures in order to achieve a fixed level of expected utility. The result is the *ex ante* expenditure function

$$\tilde{e}(p, r(s), \tilde{u}) = \qquad (2.7)$$
$$\text{Min } [px + h + z] \text{ s.t. } \tilde{u} = r(s)\cdot u(x,h',z) + (1 - r(s))\cdot u(x,h^o,z)$$
$$where: \frac{\partial \tilde{e}}{\partial p} > 0, \frac{\partial \tilde{e}}{\partial r} > 0, \frac{\partial \tilde{e}}{\partial \tilde{u}} > 0.$$

In (2.7) the consumer's health status is represented by the constant full cost of health and does not appear in the expenditure function. The expenditure function is increasing in price, risk and utility.

By the envelope theorem the compensated demand for seafood is

$$(2.8) \quad \frac{\partial \tilde{e}}{\partial p} = x^c\left(p, r(s), \tilde{u}\right).$$

The consumer's dual problem is the maximization of utility subject to the budget constraint which results in the *ex ante* indirect utility function

$$(2.9) \quad \begin{aligned} &\tilde{v}\left(p, r(s), y\right) = \\ &\text{Max } \left[r(s) \cdot u(x, h', z) + (1 - r(s)) \cdot u(x, h^o, z)\right] \text{s.t. } y = px + h + z \\ &where: \frac{\partial \tilde{v}}{\partial p} < 0, \frac{\partial \tilde{v}}{\partial r} < 0, \frac{\partial \tilde{v}}{\partial y} > 0. \end{aligned}$$

The consumer's health status is represented by the constant full cost of health and does not appear in the indirect function. The indirect utility function is decreasing in price and risk and increasing in income.

By Roy's identity, the uncompensated demand for seafood is

$$(2.10) \quad -\frac{\partial \tilde{v} / \partial p}{\partial \tilde{v} / \partial y} = x\left(p, r(s), y\right)$$

By duality, when evaluated at the indirect utility function the expenditure function is equal to income

$$(2.11) \quad \tilde{e}\left(p, r(s), \tilde{v}(p, r(s), y)\right) = y$$

Also, when evaluated at the indirect utility function, the compensated demand is equal to the uncompensated demand

$$(2.12) \quad x^c\left(p, r(s), \tilde{v}(p, r(s), y)\right) = x\left(p, r(s), y\right).$$

Two straightforward properties of the (uncompensated) seafood demand are

$$(2.13) \quad \frac{\partial x}{\partial p} < 0, \frac{\partial x}{\partial r} < 0.$$

Consumption is decreasing in price and risk. The effect of seafood safety characteristics on demand involves the indirect effect

$$(2.14)\quad \frac{\partial x}{\partial s} = \frac{\partial x}{\partial r}\frac{\partial r}{\partial s} > 0 .$$

This marginal effect of safety is positive because the effect of risk on consumption is negative and the effect of safety on risk is negative. The effect of income on demand is

$$(2.15)\quad \frac{\partial x}{\partial y} \gtrless 0 .$$

The income effect is positive (negative, zero) if seafood is a normal (inferior, neutral) good.

Welfare

The economic value of all seafood meals consumed is the consumer surplus

$$(2.16)\quad CS = \int_{p^o}^{\bar{p}} x(p, r(s), y)dp$$

where $p^o$ is the current price and $\bar{p}$ is the choke price.

The value of a non-marginal increase in risk, $r^o < r'$, is the change in consumer surplus from the change in risk

$$(2.17)\quad \Delta CS = \int_{p^o}^{\bar{p}} x(p, r^o(s_1,..., s_j^{o''},..., s_S), y)dp - \int_{p^o}^{\bar{p}'} x(p, r'(s_1,..., s_j^{''},..., s_S), y)dp$$

where $r^o$ is the current level of risk and $r'$ is the new risk level. The increase in perceived risk is a result of a change in the *jth* seafood safety characteristic, for example, a Pfiesteria-related fish kill. For risk decreases the change in consumer surplus is positive, $\Delta CS > 0$ (and $\bar{p}' \geq p^o$).

The value of a non-marginal decrease in risk, $r^o > r''$, is the change in consumer surplus from the change in risk

$$(2.18)\quad \Delta CS = \int_{p^o}^{\bar{p}''} x(p, r''(s_1,\ldots,s_j^{''},\ldots,s_S), y)dp - \int_{p^o}^{\bar{p}} x(p, r^o(s_1,\ldots,s_j^{o},\ldots,s_S), y)dp$$

where $r^o$ is the current level of risk and $r''$ is the new risk level. The change in risk is a result of a change in the $jth$ seafood safety characteristic, for example, implementation of a seafood inspection program. For risk reductions the change in consumer surplus is positive, $\Delta CS > 0$ (and $\overline{p}'' \geq p^o$).

The consumer surplus is based on the uncompensated demand functions. Definitions of the compensated surplus measures of the value of risk change can be specified with the compensated demand functions in which utility is held constant. Another approach is with the expenditure function. The value of avoiding a risk increase, holding utility constant, is equal to the difference in expenditure functions

$$(2.19)\quad WTP' = \tilde{e}\left(p, r'\left(s_1,..., s_j^{'},..., s_S\right), \tilde{u}\right) - \tilde{e}\left(p, r^o\left(s_1,..., s_j^o,..., s_S\right), \tilde{u}\right)$$

where willingness to pay, *WTP'*, is positive for avoiding the risk increase. Willingness to pay is the amount of money by which the expenditures necessary to reach the current utility level increase when risk is increased.

The value of a risk reduction, holding utility constant, is equal to the difference in expenditure functions

$$(2.20)\quad WTP'' = \tilde{e}\left(p, r^o\left(s_1,..., s_j^o,..., s_S\right), \tilde{u}\right) - \tilde{e}\left(p, r''\left(s_1,..., s_j^{''},..., s_S\right), \tilde{u}\right)$$

where willingness to pay, *WTP"*, is positive for risk reductions. Willingness to pay is the amount of money by which the expenditures necessary to reach utility decrease when risk is reduced.

Implications

Empirical analysis of this simple model of consumer behavior, perceived risk and welfare requires the collection a number of variables. In the next few chapters we describe the collection of measures of seafood consumption, risk perceptions, and willingness to pay. In later chapters we show how these theoretical constructs can be measured using indirect (e.g., revealed and stated behavior demand models) and direct (e.g., contingent valuation) methods.

## Chapter 3. Survey Design

In this chapter we describe the phone-mail-phone survey, focus groups, one-on-one surveys, and the pretest survey. The information included in the brochure was pretested in two focus groups. The survey questions were pretested in a classroom exercise at East Carolina University and in one-on-one interviews. Finally, a four state pretest of 160 households was conducted. The phone-mail-phone survey was designed to consist of the first telephone survey in which respondents would be asked if they would participate in a follow-up survey. Those who agreed would be mailed a brochure about Pfiesteria. About one-month later, respondents would be contacted again.

### Survey Development

Two focus groups were conducted to develop the Pfiesteria information mailout text and visual aids. The first focus group was conducted in Washington, NC and included five members of a local environmental organization. The second focus group was conducted in Baltimore, MD with ten members of a church group. During each session, the facilitators presented sections of the information mailout and asked participants for their thoughts on what information they thought the text and visual aids conveyed. Overall, participants found the information straightforward. Where appropriate, suggestions received during these sessions were incorporated in the final version of the mailed information.

The survey questions were developed with input from participants in an East Carolina University undergraduate environmental economics course and during 15 one-on-one (telephone and in-person) interviews. Participants in the one-on-one interviews were chosen based on convenience. These sessions focused on question wording, organization, and skip patterns. Suggestions received during these sessions were incorporated in the final version of the questionnaires.

A pretest of 160 seafood eaters in Delaware, Maryland, North Carolina, and Virginia was conducted during June-July 2001. Frequency and statistical analyses of the pretest data revealed no major flaws in the questionnaire. Only minor changes were made to the questions.

### The First Survey

The first telephone survey was designed to collect information on seafood consumption patterns and costs, seafood demand, seafood health risk, attitudes about seafood and Pfiesteria, and socioeconomic information (see Appendix A). The interviewer began with a short introduction in which they requested speaking with someone in the household over 18 years of age who eats seafood. If no one in the household met this criterion then the household was ineligible for the survey.

*Frequency of Seafood Consumption*

The first few questions gathered information on the frequency of seafood consumption (OFTEN through FISH). The goal was to obtain a valid point estimate of the number of seafood meals that the respondent ate during the past month. Interviewers instructed respondents to consider those seafood meals consumed at home or at restaurants and finfish or shellfish. Ineligible meals were those eaten at someone else's home and canned seafood. If the interviewer was asked, frozen seafood, including fishsticks or TV dinners, were eligible. The survey began with the general question: "do you eat seafood about once or twice a year, about once or twice a month, about once a week, or more than once a week?"

Next they were asked for the number of seafood meals eaten "last week" and "last month." Those who were not able to recall the number of meals last month were prompted with a question asking if they ate four times the number of meals they ate last week. Those who said they did not eat four times the meals last week were then asked if they ate more or less. This number was either added to or subtracted from the four times last week prompt to obtain the number of seafood meals eaten last week.

This final number of seafood meals last month could be equal to zero. All respondents were asked if the number of seafood meals eaten during the past month is typical. Respondents who ate zero meals last month and said that this was typical were then thanked for participating in the survey. No further questions were asked. All respondents who said last month was not typical were then asked for the number of meals eaten during a typical month.

*Types of Seafood*

The next series of questions determined the types of seafood consumed and how it was prepared (TYPES through FISH). Respondents were first asked to consider the types of seafood they ate last month, or in a typical month if they did not east any seafood last month. They were asked if they ate finfish, shellfish or both. Those who ate finfish were asked for the number and kinds of finfish meals eaten last month. If respondents said that did not know the kinds of finfish, the interviewer was instructed to read a list of finfish types and then check each type. Then respondents were asked for how the finfish was cooked and interviewers were instructed to check all answers that were given. Respondents who ate shellfish were led through three parallel questions about the number of shellfish meals, the kinds of shellfish, and how it was cooked.

Next, respondents were asked about the source of their seafood meals. The first question asked for the number of seafood meals cooked at home during the last month. For the seafood meals cooked at home respondents were asked for the number prepared from seafood bought from a vendor at the side of the road, from a fresh seafood market, the seafood counter at the grocery store, the frozen seafood section at the grocery store, and from fish that was caught by someone in the household. Respondents were asked for the number of meals eaten at a restaurant during the next section of the survey.

*Costs of Seafood Meals*

A number of questions were asked in order to determine the average cost of a seafood meal (FISHTRIP through LOWERD). For respondents who caught their own fish, no market price for the fish exists. So, our goal was to provide a proxy for the price through the cost of the fishing trip. Respondents were asked about the number of fishing trips taken by the household last month that resulted in edible seafood, the number of miles driven to the place usually fished, and the number of hours fished.

Respondents who cooked seafood at home were asked a series of questions designed to determine the typical cost of preparation: "Think about the average or typical amount of money you spent on YOUR portion of each home-cooked seafood meal last month." The question was closed-end with a starting price as prompt: "was the price higher than $A, lower than $A, or about $A" where $A was equal to $5 or $9. Respondents who paid higher than $A were then asked if the price was higher than the next highest dollar integer until they reached "more than $20." Respondents who paid less than $A were then asked if the price was lower than the next lowest dollar integer until they reached $1.

After answering a question about the number of seafood meals eaten at restaurants during the last month, respondents were asked to: "Consider the money you spent on seafood at a restaurant last month, including appetizers and main dishes. Think about the average or typical amount of money you spent on YOUR portion of each seafood meal." Respondents were then led then through a series of questions similar to the home-cooked price questions with the starting price, $B, equal to $9 and $13, the maximum price equal to "more than $25" and the minimum price equal to $1.

<u>Hypothetical Demand Scenarios</u>

The next section of the survey posed a series of hypothetical questions about the number of seafood meals eaten "next month" under different scenarios (NXTMONTH through LOWER). The first question was designed to provide an estimate of the number of meals, all else equal: "Thinking about the seafood meals you ate last month again, if the average price of your seafood meals stay the same, do you think you will eat more, less or the same number of seafood meals next month?" Respondents who would not eat the same number were asked how many more or less they would eat the next month.

Respondents were next presented with scenarios in which the price rises and falls and are asked to compare the number of meals that they would eat next month with the different price to the number of meals they ate last month. Respondents are told: "Seafood prices change over time. For example, if a lot of fish are caught, prices go down. When fewer fish are caught, prices go up. Suppose the price of your seafood meal goes up by $B, but the price of all other foods stays the same." Each respondent randomly received one seafood price change, $B, that took on four possible values: $1, $3, $5, or $7. Respondents were then asked: "Compared to the [insert meals last month] meals you ate last month, do you think you would eat more, less, or the same number of meals next month with the higher price?" Respondents who would eat more or less were then asked how many more or less seafood meals they would eat next month.

The next scenario presented a price decrease: "Now suppose the price of your average seafood meal goes down by $C but the price of all other food stays the same." The hypothetical price decrease took on one of four possible values: $1, $2, $3, or $4. Then respondents were asked: Compared to the [insert meals last month] seafood meals you ate last month, do you think you would eat more, less, or the same number next month with the lower price?" Respondents who would eat more or less were then asked how many more or less seafood meals they would eat next month.

Seafood Safety

The next series of questions were about how safe respondents think seafood is to eat. Respondents were asked to: "think about the type of illness that would make you go to the doctor, miss work, or miss some other activity, after you ate. Try not to think about allergic reactions or long-term problems from eating." They were then asked the general question: "Do you think seafood is very safe to eat, somewhat safe to eat, somewhat unsafe to eat, or very unsafe to eat?"

Relative risk information was next gathered. Respondents were asked to: "compare the safety of seafood with poultry, including chicken and turkey, and meat, including beef and pork." Then they were asked which food they thought was most and least likely to make them sick if they ate it.

Next, a series of questions attempted to gather qualitative and quantitative perceived risk information. The qualitative risk question asked: "To get a better idea of how safe you think you are from eating seafood, consider the seafood meals you expect to eat next month. What do you think are your chances of getting sick from eating these meals? Do you think they are very likely, somewhat likely, somewhat not likely, or not likely at all?" This question was followed by the quantitative risk question: "Do you think your chances are greater or less than 1%?" The interviewers accepted the potential answer categories "more," "less," or "about 1%."

Respondents who perceive that their chance of getting sick is less than one percent were asked a follow-up question with a lower risk amount: "This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in D?" The denominator D took on one of four possible values: 1000, 10,000, 100,000, or 1,000,000.

The last three questions asked if respondents were very concerned, somewhat concerned, or not concerned about seafood handling practices, the freshness of seafood and diseases in fish.

Perceptions about Pfiesteria

The next series of questions were designed to develop an understanding about respondent perceptions about Pfiesteria.[1] Respondents were first asked if they had ever heard about Pfiesteria. Those respondents who had heard about Pfiesteria were asked a knowledge question: "To the best of your knowledge, would you say that Pfiesteria is a form of pollution, a disease in fish, a toxic organism, a predator that attacks fish, or a parasite in fish?" Respondents were then told: "Pfiesteria is a potentially toxic organism that has been associated with fish kills in coastal waters from Delaware to North Carolina." Then we asked whether respondents knew whether Pfiesteria outbreaks had occurred in their state during the past month.

Respondents were asked about how concerned they were about Pfiesteria, had they ever avoided eating seafood because of a Pfiesteria outbreak, and would a Pfiesteria outbreak in their state next week reduce the number of seafood meals they would eat during the next month. Next respondents were asked to agree or disagree with five statements with answers based on a four-point Likert scale: strongly agree, agree, disagree, or strongly disagree. Three statements were about safety: "It is safe to swim in coastal waters during a Pfiesteria outbreak. It is safe to breathe the air around coastal waters during a Pfiesteria outbreak. It is safe to eat seafood from an area where a Pfiesteria outbreak has happened." Two statements were about the cause of Pfiesteria: "Pollution from farms can cause Pfiesteria outbreaks. Pollution from factories can cause Pfiesteria outbreaks."

Socioeconomic Information

The last section of the survey gathered information about the household (STATE through INCOMEG). Respondents were asked about how long they had lived in their state of residence, what county they lived in, how long they had lived in the county, and for their zipcode. The next questions were about the people in the household. Respondents were asked how many people lived in the household, how many of these were under 18 years of age, if the respondent is male or female, the race or ethnic background of the respondent, the year of birth, and the highest level or grade in school completed.

A series of questions about the household income were presented next. The first question asked: "As close as you can recall, how much income did you household earn last year? Was it above or below $40,000?" Respondents who answered above $40,000 were then asked if income was above $50,000, then $75,000, and then $100,000. Respondents who answered below $40,000 were then asked if income was below

[1] These questions were based on similar questions from Falk, Darby, and Kempton (2000).

$30,000, $20,000, and then $10,000. In this way we learn the interval within which household income falls.

Recruitment

The last few questions were designed to recruit respondents for the follow-up survey. Respondents were told: "Based on your answers to these questions we would like for you to participate in a short follow-up survey in about a month. The survey is about Pfiesteria and seafood safety. The questions only take about five minutes." They were then asked about their willingness to participate in the follow-up survey.

Respondents who were willing to participate were thanked and then told: "In about a week, we'll send you some information about Pfiesteria and seafood safety in the mail. In about a month, we'll call back and ask for your opinions about that information." Then they were asked for their name and mailing address.

Respondents who declined to participate in the follow-up survey were asked the open-ended question: "What is the main reason you don't want to participate in the follow-up survey?" The interviewers were instructed to check all the answers given from among the following categories: "I don't have enough time, I don't like these questions or survey, I think you're trying to sell me something, I'm moving soon, I don't want to eat seafood anymore, I'm not interested, or some other reason."

The Information Mail-out

The information mail-out consists of four parts (see Appendix B). The major part is the Pfiesteria brochure titled "What you should know about Pfiesteria" which was based on the brochure published by the U.S. Environmental Protection Agency's Office of Water titled "What you should know about Pfiesteria Piscicida."[2] The brochure and the "counter information" insert followed the same format with the same headings and edited text. The brochure also consisted of "fish kill information," "seafood inspection program," and "hypothetical fish kill" inserts.

*Pfiesteria Brochure*

The brochure was accompanied by a cover letter stating that: "The purpose of this study is to better understand seafood consumption patterns and to get your opinions about seafood safety." It also thanked respondents for participating and to consider the information carefully. Each letter was individually signed. The cover of the brochure informs respondents that the booklet provides information about Pfiesteria and

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[2]See: http://www.epa.gov/owow/estuaries/pfiesteria/fact.html. The brochure and insert information was simplified by the authors and revised based on comments received from focus groups and from a review by an ecologist familiar with the Pfiesteria scientific literature.

emphasizes that the issue is important to the economy of the Mid-Atlantic region. Again, respondents were asked to carefully consider the information. The brochure was printed on glossy paper in four-color with several photographs illustrating the text.[3]

Each section of the Pfiesteria brochure includes one or two short paragraphs. The first page included three sections. The first section of the brochure (What is Pfiesteria?) began with a simple definition of Pfiesteria: "Pfiesteria is a potentially toxic organism that has been associated with fish kills in coastal waters from Delaware to North Carolina." This section also defined a fish kill and that Pfiesteria is a natural part of the environment and is accompanied by a picture of a scientist peering into a microscope. The second section (How does Pfiesteria affect fish?) explains that Pfiesteria stuns with released toxics and that the toxins are believed to cause sores on fish (i.e., lesions). Photographs of menhaden with lesions accompany the text. The third section (How long do toxic Pfiesteria outbreaks last?) states that toxic outbreaks of Pfiesteria are short but Pfiesteria-associated fish kills can last for days or weeks.

The second page included three additional sections. The fourth section of the brochure (Is Pfiesteria the only cause of fish sores and fish kills?) describes other sources of fish kills and sores. A photograph of dead fish floating on the water near the shoreline accompanies the text. The fifth section (Where has Pfiesteria been found?) then describes more fully where Pfiesteria has and has not been found with an illustrative map. The sixth section (What causes Pfiesteria outbreaks?) emphasizes the scientific uncertainty about Pfiesteria by using qualifiers to describe each source of outbreaks including the presence of a large number of fish, pollutants and excess nutrients.

The back page of the brochure contained three sections. The seventh section of the brochure (Can Pfiesteria cause human health problems?) stated that "exposure to waters where toxic forms of Pfiesteria are active may cause memory loss, confusion, and a variety of other symptoms including respiratory, skin, and gastrointestinal problems." This section also included the statement: "There is no evidence that Pfiesteria-associated illnesses are associated with eating finfish or shellfish." The eighth section (Is Pfiesteria related to red and brown tides?) stated that brown and red tides and Pfiesteria are types of harmful algal blooms. The ninth section (What should I do to report fish sores or fish kills?) provided state Pfiesteria hotline numbers.

*Counter Information Insert*

The purpose of the counter information insert is to provide additional information about seafood, swimming and boating safety and Pfiesteria and inform respondents about the governmental response to Pfiesteria. This insert was printed in two-color on glossy paper. The insert contained three sections. The first section (Is it safe to eat seafood?), accompanied by a black and white photo of finfish and shellfish laid out on ice,

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[3] The brochure is available from the authors or at: http://www.csb.uncw.edu/people/whiteheadj/research/ecohab/.

emphasizes that it is safe to eat seafood. Three facts are stated: there has never been a case of Pfiesteria-related illness from seafood, there is no evidence of Pfiesteria contamination in seafood and there is no evidence of Pfiesteria-related illnesses from eating seafood.

The second section (Is it safe to swim and boat in coastal waters?) emphasized that swimming and boating are safe. Respondents are cautioned to avoid contact with fish and water where significant numbers of fish are dead or have sores. Respondents are also cautioned to contact their physician if they have health problems after being exposed to fish, water, or air at the site of a fish kill. A black and white picture of a sailboat in open water accompanies this section.

The third section (What is being done about Pfiesteria?) informs respondents that state and federal agencies, local governments and academic institutions are working together to understand Pfiesteria. A list of federal agencies, and what they are doing (e.g., monitoring, funding research, and making information available), is provided.

*Fish Kill Information and Seafood Inspection Program Insert*

The fill kill information and seafood inspection program insert was printed in two-color on glossy paper. Each source of information was printed on one side of the insert. The fish kill information page describes "what some people consider to be typical" major and minor Pfiesteria-associated fish kills. The major fish kills "typically involve hundreds of thousands of fish over large areas of river surface." Fish species include menhaden, croaker, and flounder. A minor fish kill is described as involving less than ten thousand menhaden.

A bar chart accompanied the text in which the fish kills are illustrated: (high) 300,000 menhaden and significantly fewer croaker and flounder, (low) 100,000 menhaden and significantly fewer croaker and flounder and (minor) 10,000 menhaden. Graphic illustrations of the three species of fish illustrate their relative size.

The U.S. Department of Commerce's (USDC) voluntary seafood inspection program is described on the next page. For a $49.30 hourly fee USDC seafood inspectors serve as sanitation advisor, quality control monitor, and official certifier. Participating producers and processors receive the U.S. Grade A seal of approval.

The next section describes a proposed mandatory inspection program. The text suggests that only a small number of producers participate in the voluntary program due to the resulting higher prices. The mandatory program would require that all seafood producers participate in the inspection program and that all seafood would receive the U.S. Grade A seal of approval.

*Hypothetical Fish Kill Insert*

Respondents were asked to consider a hypothetical fish kill that is described in a press release. Respondents are told that the press release is based on actual fish kills but are reminded that this fish kill did not happen. The hypothetical fish kill is based on an August 1, 1999 press release from the Maryland Department of Natural Resources about a 500,000 menhaden fish kill on the lower Pokomoke River.

There are four versions of the hypothetical fish kill: Maryland major, Maryland minor, North Carolina major, and North Carolina minor. The Maryland fish kill occurs on the lower Pokomoke River between Shelltown and Fair Island. The North Carolina fish kill occurs on the lower Neuse River between New Bern and Slocum Creek. A black and white map on the back of the sheet illustrates the location.

The major fish kill occurred over a "large" area of the river and affected 300,000 menhaden, 10,000 croaker, and 5,000 flounder. Lesions were observed on over 75% of the fish. The minor fish kill occurred over a "small" area of the river and affected 10,000 menhaden. Lesions were observed on over 50% of the fish.

The rest of the press release is identical for all four versions. Respondents are told that a laboratory indicated that Pfiesteria was involved in the kill. The public is advised to avoid contact with the fish and water in the area of the fish kill.

The Second Survey

The second (follow-up) survey was designed to collect information on seafood demand, seafood health risk, and attitudes about seafood and Pfiesteria (see Appendix C). Most of the questions were identical or similar to questions asked in the first survey. The main purpose of these questions is to determine if seafood demand, perceived health risk and attitudes about Pfiesteria change after receiving the information. In the second survey, the hypothetical demand questions were presented in different sections.

The second survey first asked to speak with the person who completed the first survey. Upon reaching that person, respondents were reminded that about a month ago they talked to someone from the ECU Survey Research Laboratory about seafood safety and then told some information about seafood and fish kills had been mailed to them. Respondents were then asked if they received that information. If not, the interviewer checked the respondent's address and mailed the information again. Respondents who had received the information were asked if they had a chance to read it yet. If not, the interviewer told the respondent: "we will call you back in about a week or so to complete the survey."

Once we reached respondents who had read the information, questions were asked about the information including if respondents had read all or just some of it and if they had read it very closely, somewhat closely, not very closely, or not closely at all. Respondents were also asked if they had the information with them. If not, they were told that they did not need it in front of them to do the survey. We did not require the information in order to simulate a consumer who acquires information and then proceeds to the market without that information.

*Frequency of Seafood Consumption*

The first set of questions asked about seafood consumption during the past month and expected seafood consumption during the next month (OFTEN2 through EATMONT2). Respondents were asked the same questions as before including a general question about seafood consumption, the number of meals eaten last week and last month. Respondents who could not recall the number of meals last month were asked to consider whether they ate more, less, or about the same as four times the number of meals last week. Respondents were again asked if this was a typical month and, if not, how many meals were eaten in a typical month.

The same hypothetical question about the number of meals next month, if the average price of seafood stays the same, was next asked. Respondents who would eat more or less than last month were asked how many.

Perceptions about Pfiesteria

After asking several questions about respondent understanding of the mailed out information, respondents were asked the same questions about Pfiesteria as in the first survey (UNDRPFST through FACTORY2). The questions about understanding Pfiesteria began with: "In terms of understanding Pfiesteria, did you find the information we sent you very helpful, somewhat helpful, not very helpful, or not helpful at all?" Then respondents were asked if they had "heard or read anything about Pfiesteria since the first survey" and if yes, if they had "read about it in the newspapers, heard about it on television or something else?"

Then respondents were asked identical questions from the first survey about their knowledge about Pfiesteria, how concerned they were, if they had ever avoided eating seafood because of a Pfiesteria outbreak, and if they would reduce the number of seafood meals eaten next month if a Pfiesteria outbreak occurred in their state next week. Respondents were then asked to agree or disagree with the five same statements from the first survey claiming that it is safe to swim, breathe, and eat after a Pfiesteria outbreak and that pollution from farms and factories causes Pfiesteria.

Questions About the Fish Kill

A series of questions about the hypothetical fish kill was then presented (BROC1 through CHANGE). Respondents were first reminded about the fish kill information that they received in the mailed information. For example, the Maryland major version stated: "Now think about the hypothetical fish kill information that we sent you. The Pfiesteria-associated fish kill affected about 300,000 menhaden, 10,000 croaker, and 5,000 flounder over a large portion of the Pokomoke River. Lesions were observed on over 75% of the menhaden." Similar statements were read for the Maryland minor and North Carolina major and minor versions. Respondents were then asked: "Do you think this hypothetical fish kill is very realistic, somewhat realistic, not very realistic, or not realistic at all?" They were also asked if they considered the fish kill a major or minor fish kill.

Respondents in the North Carolina sample were asked if they ever ate seafood caught from the Neuse River and North Carolina. They were then asked: Now imagine that this fish kill really happened last week. Would this make you think that seafood from the Neuse River was not safe to eat?" Identical questions were asked all other respondents with the Pokomoke River and Maryland substituted.

Seafood Safety and Demand after the Fish Kill

The next series of questions were about how safe respondents think seafood is to eat after the hypothetical fish kill (CHANCE2 through CHAN4B). Respondents were again asked the qualitative and quantitative risk questions. The quantitative questions asked if respondents thought their chances of getting sick were greater or less than 1%. Those who answered less than were presented one of four randomly selected probabilities, D, and asked the same question. The purpose of these questions is to determine the change in risk perception after reading the mail out information and considering the hypothetical fish kill.

The hypothetical demand question was then asked: "Thinking about seafood meals again, suppose that the average price of your seafood meals stay the same. Compared to the [insert meals last month] meals that you ate last month, do you think you would eat more, less, or the same number next month after the fish kill?" Those who answer more or less are asked the follow-up question to determine how much. Then respondents are asked if anything else about their eating habits would change.

Seafood Safety and Demand after the Seafood Inspection Program

The next series of questions were about how safe respondents think seafood is to eat after the hypothetical fish kill and with the mandatory seafood inspection program (INSPECT through MORELESS). Respondents were first reminded that: "We also sent you some information about the U.S. Department of Commerce's voluntary seafood inspection program." And asked: "Do you think the information that we sent you is very clear, somewhat clear, not very clear, or not clear at all?" They were also reminded that it has been proposed to make the voluntary program a mandatory program so that: "all the seafood you ate from restaurants, grocery stores, and fresh seafood markets had the Grade A seal of approval."

Respondents were again asked the qualitative and quantitative risk questions. The quantitative questions asked if respondents thought their chances of getting sick were greater or less than 1%. Those who answered less than were presented one of four randomly selected probabilities, D, and asked the same question. The purpose of these questions is to determine the change in risk perception after reading the mail out information and considering the hypothetical fish kill and mandatory seafood inspection program.

The hypothetical demand question was then asked: "Now suppose that the average price of your seafood meals stay the same. Compared to the [insert meals last month] meals that you ate last month, do you think you would eat more, less, or the same number next month after the fish kill and with the mandatory seafood inspection program?" Those who answer more or less are asked the follow-up question to determine how much.

Next, respondents were told that: "Only a small number of seafood producers participate in the voluntary seafood inspection program. The main reason is that some businesses think the program will result in higher prices." Respondents were then asked if they thought the program would make seafood prices higher and presented with a hypothetical demand question with a higher price: "Suppose that with the mandatory seafood inspection program the price of your portion of your average seafood meals goes up by $B, but the price of all other food stays the same. Compared to the [insert meals last month] meals you ate last month, do you think that you would eat more, less, or the same number next month after the fish kill?" Again, respondents were presented with one of four randomly assigned value for $B: $1, $3, $5, and $7. A follow-up question was then asked to determine how much more or less seafood respondents would eat.

Summary of Hypothetical Demand Scenarios

The hypothetical demand questions from the first survey allow the demand curve for seafood to be traced out for each respondent. In combination with the revealed preference response in the first section of the survey, there are four data points: revealed preference last month (RP1), stated preference next month (SP1), stated preference next month with the higher price (SP1-HP), and stated preference next month with the lower price (SP1-LP).

The hypothetical demand questions from the second survey allow shifts in the demand curve for seafood to be measured for each respondent. There are five data points: revealed preference last month (RP2), stated preference next month (SP2), stated preference next month after the fish kill (SP2-FK), stated preference next month after the fish kill and with the mandatory seafood inspection program (SP2-FK-SIP), and stated preference next after the fish kill, with the mandatory seafood inspection program, and higher seafood prices (SP2-FK-SIP-HP).

Willingness to Pay Questions

The purpose of the next set of questions was to elicit respondent willingness to pay for the mandatory seafood inspection program: "Suppose that the proposed mandatory seafood inspection program is put to a vote in the November national election. If more than one-half of all people voted for it the Department of Commerce would put it into practice. If you knew the price of your portion of your average seafood meal would go up by $1 but the price of all other food stays the same, would you vote for or against it?" Respondents could answer for, against, or don't know.

A follow-up question asked: "Are you very sure, somewhat sure, not very sure or not sure at all that you would vote for (against) the proposal?" We also asked: "How likely is it that you will vote in the November national election?" Are you very sure, somewhat sure, not very sure, or not sure at all?" Post-election versions of these questions were also written for those respondents who completed the telephone survey after the election.

Debriefing Questions

Finally, we asked a series of questions designed to determine how well respondents understood the questions they were answering. The first question was: "During this survey, we asked you many questions about how many seafood meals you would eat under hypothetical situations. Did you understand these questions very well, somewhat well, not very well, or not at all?" The second question was: "Were these questions very hard, somewhat hard, somewhat easy, or very easy to answer?" Finally, the third question was: "How sure were you about your answers? Were you very sure, somewhat sure, not very sure, or not sure at all?" In closing the survey, interviewers offered to mail a summary of the survey results to respondents in about one year.

References

Falk, James M., Forbes L. Darby, and Willett Kempton, "Understanding Mid-Atlantic Residents' Concerns, Attitudes, and Perceptions about Harmful Algal Blooms: Pfiesteria Piscidida," University of Delaware, Sea Grant College Program, DEL-SG-05-00, August 2000.

# Chapter 4. Data Summary

This chapter describes the survey data. We begin with a description of the sample including the stratified sample frame, response rates, and the construction of weights. We then summarize the demographic characteristics of the sample after imputation for missing values and weighting. In the second section we compare all variables collected during the first survey across state and other relevant groups. In the third section we present a summary of the variables collected during the second survey and compare these across state. Where appropriate, we compare responses from the first and second survey.

## The Sample

### *Sample Frame*

The sample included seafood eaters in all of Delaware and the eastern parts of Maryland (including the District of Columbia), North Carolina and Virginia. According to 1999 U.S. Census Bureau population estimates, the total population of the sampling frame is 12,084,773. The sample frame was stratified based on 50/50 urban/rural split and 50/50 based on a North Carolina/rest of sample split.

There are twelve sub-samples based on the experimental design of the information treatments (Table 4-1). Among the target sample size of 2000 seafood eaters in North Carolina, Delaware, District of Columbia, Maryland, and Virginia, 1600 were to receive the Pfiesteria brochure and 800 of these were to receive the counter information. Twenty-percent of each sample were to receive neither sources of information.

The goal was to conduct the survey during fish kill season: June through November. The East Carolina University Survey Research Laboratory (SRL) conducted the first telephone survey from August to October. About one week after respondents agreed to participate in the second telephone survey SRL personnel mailed the information. About three weeks after the information was mailed SRL interviewers attempted to contact the respondents. The second survey was conducted from October through November.

### *Response Rates*

Almost nine thousand calls were made in an attempt to reach 2000 respondents (Table 4-2). One thousand eighty hundred and seven completed interviews were conducted and 11 were partially completed. Of the attempted calls, 1187 reached a household that did not contain a seafood eater (no eligible respondent). Excluding other ineligible contacts (e.g., business numbers, answering machines), refusals include hard (569) and soft (585) refusals and those selected respondents who asked the interviewer to call back at another time (21). Dividing the completed interviews by contacts (contacts = refusals + completed interviews) yields the response rate of 60.7%.

This response rate varies significantly by state. The response rate in North Carolina was highest with 69% and 1085 completed interviews. The response rates in Delaware, District of Columbia, Maryland and Virginia were 52.9%, 46.2%, 48.7%, and 54.4%. The number of completed interviews was 237, 47, 216, and 222, respectively. These differences are probably attributable to the name recognition of East Carolina University in eastern North Carolina and the lack thereof for the rest of the sample.

One thousand four hundred and three respondents agreed to participate in the second survey. This represents 77% of respondents to the first survey and 46.9% of those contacted for the first survey. Of these 1149 were contacted with 846 completing the interview. After deleting coding errors between the first and second survey, 835 completed interviews remain. The response rate to the second survey is 72.7% of those who were contacted for the second survey and 27.9% of those contacted for the first survey. The response rate to the second survey of those who agreed to participate and were contacted is 70.1%, 43.5%, 81.7%, 73.5%, and 76.9% for Delaware (101 respondents), District of Columbia (10), Maryland (98), North Carolina (533), and Virginia (93).

Upon closer inspection of the sample, 21 respondents to the first survey lived outside the sampling frame and were discarded as ineligible. This leaves a sample size of 1797.

*Weights*

Weights were constructed in order to account for the sample stratification (Appendix E). County and city population estimates for 1999 were obtained from the U.S. Census Bureau. The weight is equal to the county percent of the sample divided by the county percent of the population. Several contiguous counties with small sample sizes were combined in order to keep the weight in single digits.

After combining the Maryland and the District of Columbia samples state level weights were created. The full sample weight was multiplied by the state sample size and divided by the sum of the weights for the state

$$WT_{state} = WT_{full sample} \times \frac{n_{state}}{\sum_{j=1}^{n_{state}} WT_{full\ sample}}.$$

Each of the state level weights sum to the sample size for the state.

Four cases were deleted because the age, AGE, of the respondent is less than 18 leaving a sample of 1793. After deleting these cases the sum of weights does not equal the sample sized. The weights are scaled so that the sum of the weights is equal to the sample size

$$WT_{n=1793} = WT_{n=1797} \times \frac{1793}{1793.53}$$

where 1793.53 is the sum of the raw weights.

Using the state level weights, counties are defined as urban if the weight is greater than one. In other words, these counties were undersampled according to the stratification rule. The exception is the District of Columbia that is defined as urban. The urban variable, URBAN, is equal to 1 for an urban county and zero otherwise. Thirty-six percent of the sample resides in urban counties and the District of Columbia. By state, the percentage of urban residents is 59, 81, 20, and 31 in Delaware, Maryland, North Carolina and Virginia.

Demographics

We collected seven demographic variables. Since the questions were asked in year 2000, age is equal to 100 minus the last two digits of the year the respondent was born (e.g., 100 – 45 = 55 years old). Respondent sex, MALE, is equal to 1 if male and 0 if female. Two missing sex variables are recoded as female (the mode). Respondent race, WHITE, is equal to 1 if the respondent is white and 0 otherwise. HOUSE is the size of the household. The number of children younger than 18 in the household is CHILDREN. The number of years of schooling, EDUC, is top-coded at 20 years (for those receiving a doctorate). One miscoded EDUC variable (EDUC = 79) is recoded as missing. Missing EDUC values (n=4) are replaced with the median years schooling (EDUC=14). Respondent tenure in the state, STATE, is the number of years lived in the state. Three missing values are imputed with the median (STATE=30). Respondent tenure in the county, LENGTH, is the number of years lived in the county. Eight missing values are imputed with the median (LENGTH=20).

With one exception, annual household income is coded at the midpoint of the income intervals resulting from the iterative income questions. For example, if a respondent made more than $40,000 and less then $50,000, their income is coded at $45 (in thousands). Income values are top coded at $100 and bottom coded at $5. The exception is for those who answered “about right” (n=113) to the first ($40,000) income question who are coded at $40. The average income is $52.67 with 255 missing values (n=1538).

Missing income values were imputed with predictions from an ordinary least squares regression model (Table 4-3). The dependent variable is the natural log of income. Income is increasing in education and experience (at a decreasing rate). Income is increasing in household size but decreasing with the number of children. Income is higher for whites and males. The adjusted $R^2$ is .27 and the F statistic is statistically significant at the p=.01 level. We conclude that the income equation is reliable for data imputation.

Predictions from the model are re-coded to the mid-point of the income intervals (Table 4-4). The average predicted income value is $34.70 which is significantly different from the mean income value of $52.67 at the p=.01 level. Most of the predicted income values fall between $20,000 and $30,000 (n=67) or $30,000 and $40,000 (n=102). Fewer values fall lower than $10,000 (n=6), between $10,000 and $20,000 (n=14), between $40,000 and $50,000 (n=45), $50,000 and $75,000 (n=20), and $75,000 and $100,000 (n=1). No predicted values are greater than $100,000.

The average age is almost 47 years (Table 4-5). Almost two-thirds of the sample is female and over two-thirds of the sample is white. The average household size is 2.72 with an average of .72 children. The average education level is 14 years. The average annual household income is $50.12. The average tenure in the state and county is 31 and 24 years.

The weighted means are very similar. The weighted average age is 46.69. The sample is over-represented by whites and by females. The weighted average household size is 2.69 and the weighted average number of children is .70. The weighted average annual household income is $50.12, indicating that lower income households are slightly under-represented. The sample is slightly over-represented by those with longer tenure. The average tenure in the state and county is 30 and 22 years.

A comparison of demographic variables across state reveals several differences (Table 4-6). The percentage of males and whites is larger in Delaware. The percentage of whites is lowest in Maryland (including District of Columbia). Education and income are lowest in North Carolina. Tenure in the state is highest in North Carolina. Tenure in the county is lowest in Virginia. Household size and the number of children are similar across states.

A comparison of demographic variables for those who responded to the first survey only and those who responded to the second survey reveals several differences (Table 4-7). Respondents to the second survey are more likely to be white with higher education and household income levels. Each of these differences is statistically significant at the p=.01 level.

We also attempted to determine other factors that affect the choice to respond to the second survey using the logistic regression model. After including demographic variables, of which the coefficients on WHITE, EDUC, and INCOME are statistically significant, only one other independent variable is a statistically significant predictor. Respondents who had heard about Pfiesteria are more likely to respond to the second survey. Other variables included are the number of seafood meals and measures of perceived seafood safety.

Data Summary: First Survey

*Frequency of Seafood Consumption*

Frequency responses to question about how often the respondent eats seafood finds that there are significant differences across states at the p=.05 level (Table 4-8). Maryland residents eat seafood weekly more often than other residents. The other states have between 45% and 49% of residents who only once or twice a month. About 5% in each state eat seafood about once or twice a year. North Carolina residents eat the least seafood with only 14% eating seafood more than once a week.

The average number of seafood meals eaten last month, NUMBER1, also varies across state with almost 6 meals per month consumed in Maryland and only 4 meals per month consumed in North Carolina (Table 4-9).[4] In each state, about 80% of the sample said that this represents seafood consumption in a typical month (TYPICAL). For those non-typical month respondents, the number of seafood meals eaten in a typical month (TYPMONTH) is below 3 meals for Delaware, North Carolina, and Virginia, and 4 meals for Maryland. The average difference in the number of seafood meals consumed last month and a typical month is 1.92 meals (n=304). This difference is significant at the p=.01 level according to the signed rank test.

*Types of Seafood*

There are no statistically significant differences in the frequencies of the type, finfish, shellfish, or both, of seafood eaten across state (Table 4-10). Most respondents eat both finfish and shellfish. Between 17% and 22% of respondents eat only finfish. Between 14% and 21% eat only shellfish. Between 60% and 68% of respondents eat both finfish and shellfish.

Of those who eat finfish, the average number of finfish meals, FINFISH, is almost 4 in Delaware and Maryland, almost 3 in North Carolina, and 3.42 in Virginia (Table 4-11). The number of shellfish meals, NUMSHEL, is slightly lower in each state. Only North Carolina residents eat more seafood meals in restaurants, RESTAU, than at home, OWNHOME. Of those meals cooked at home, the source of the fish is most likely a seafood market, MARKET, or the seafood counter at the grocery store, GROCERY. Delaware residents are most likely to eat fish that they caught, FISH. Few meals are based on fish from vendors “at the side of the road”, VENDOR, or from the frozen section at the grocery store, FROZEN.

Of those who eat finfish, 44% eat flounder, 21% eat salmon, 12% eat tuna and saltwater trout, and 9% eat catfish and freshwater trout (Table 4-12). Of those who eat shellfish, 73% eat shrimp, 37% eat crabs, 18% eat oysters, and 12% eat clams and scallops (Table 4-13). Most finfish (54%) and shellfish (43%) is fried (Table 4-14).

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[4] The means are not weighted.

Twenty-two percent of finfish is broiled and 18% is grilled or baked. Thirty-three percent of shellfish is steamed, 19% is boiled, and 15% is broiled.

*Costs of Seafood Meals*

Based on the final answers to the iterative questions about the costs of seafood, the average home-cooked and restaurant meal costs are $8.02 (n=997) and $13.23 (n=1289). In an ordinary least squares model, holding constant the percentage of finfish meals, the final cost is positively affected by the starting cost amount (Table 4-15). These models suggest that a $1 increase in the starting cost amount leads to a $1.19 and $1.32 increase in the final cost for home-cooked and restaurant meals.

Based on the final cost estimates and the number of home-cooked and restaurant cooked seafood meals, a weighted average cost per seafood meal variable is constructed. Several steps are taken to compute the weighted average. First, for respondents who did not eat any home-cooked or restaurant meals, the average cost of $8 and $13 is imputed.

A number of respondents have missing values (n=12) for either at home and restaurant meals or zero values (n=42) for both while the total number of meals variable, NUMBER1, is not missing. These missing values include those respondents who caught their own fish. Regression models are estimated with the number of home-cooked and restaurant meals regressed on the residual difference between the total number of meals and home-cooked and restaurant meals (Table 4-17). Both models explain over two-thirds of the variance in the dependent variable. The home-cooked model suggests that the number of home cooked meals increases by .77 for each difference in the total number and restaurant meals. The restaurant model suggests that the number of home cooked meals increases by .77 for each difference in the total number and restaurant meals.

Missing home-cooked and restaurant meals are imputed using the rounded predictions from these models (Table 4-17). For respondents who report zero home-cooked and restaurant meals, the predicted number of meals are allocated based on the average predicted percentage of home-cooked meals of .45 (n=1743). For those with zero total meals and zero home-cooked and restaurant meals (n=9), one home-cooked meal is imputed.

The survey was designed to be able to construct implicit prices for respondents who caught their own fish using distance traveled and time spent fishing. Assuming $.32 per mile, an opportunity cost of 33% of the wage rate, and average miles per hour of 50, the average trip cost is $61.12 (n=263) and the average on-site cost is $5.82 (n=259). Since so few of the total number of meals are based on fish caught by a member of the household, the difficulties associated with allocating costs for subsistence trips and pleasure trips, we do not pursue this effort. Instead, we assumed that the true cost of these meals is equal to the market price.

Note that there is measurement error between the number of home-cooked and restaurant meals, which should sum to equal the total number of meals, and the total number of meals. While 32% of the full sample (n=1797) have measurement error, the magnitude of the error is small (NUMBER1-OWNHOME-RESTAU=-.07) and not statistically different from zero at the p=.10 level.

Finally, the weighted average seafood meal price is computed as

$$AVGPRICE = \frac{(HOPRICE \times OWNHOME) + (REPRICE \times RESTAU)}{OWNHOME + RESTAU}$$

where HOPRICE is the home-cooked price and REPRICE is the restaurant price. After rounding to the nearest dollar, the average price, AVGPRICE, is $10.71 with a standard deviation of 4.91, a minimum of $1 and a maximum of $26 (Table 4-18). The frequency distribution of AVGPRICE indicates that over 74% of the prices are within the range of the starting amount prices, $5 through $13. Only 5% of the prices are less than $5 and 21% of the prices are greater than $13. Across states, the average price is highest in Maryland ($12.06) and lowest in North Carolina ($10.14). The average prices are $11.43 and $10.89 in Delaware and Virginia.

*Hypothetical Demand Scenarios*

The hypothetical seafood meals differ by scenario (Table 4-19). The number of seafood meals that respondents would eat next month, NUMBER2, is less than the number next month with a price decrease, NUMBER3, and greater than the number next month with a price increase, NUMBER4, in each state. These differences are statistically significant at the p=.01 level according to the signed rank test (Freund and Walpole, 1980). Only 1% of respondents state that they would eat less seafood when price falls. Only 3.7% of respondents state that they would eat more seafood when price rises. Comparing the hypothetical meals with the actual meals (Table 4-10) the differences are statistically significant in Delaware (p=.10) and North Carolina (p=.01) according to the signed rank test.

The means of seafood meals by price increases (PRICEUP) and decreases (PRICDOWN) are presented in Table 4-20. In general, the average seafood meals decrease as the price increases rises from $1 to $7. The exception is the increase in meals from 3.28 to 3.50 as price rises from $5 to $7. In general, the average seafood meals increase as the price decrease rises from $1 to $4. The exception is the decrease in meals from 6.32 to 6.15 as price rises from $5 to $7.

*Seafood Safety*

Most respondents think that seafood is either very safe or somewhat safe to eat (Table 4-21). When considering the number of seafood meals they expect to eat next month, more than 85% of the respondents said that they are somewhat not likely or not likely at all to get sick (Table 4-22).

Respondents in Delaware, North Carolina, and Virginia think that meat is most likely to make them sick (Table 4-23). Maryland respondents think that meat is most likely to make them sick, although one less respondent answered poultry. These differences are significantly different across state at the p=.05 level ($\chi^2$=13.25[6 df]). Most respondents in each state thought meat was least likely to make them sick with seafood a close second (Table 4-24).

Greater than 59% of respondents in each state think that the chances of getting sick from the seafood meals consumed next month is less than 1% (Table 4-25). Between one-quarter and one-third of respondents think that their chances are "about 1%" and less than 13% think that their chances are greater. Of those who think that their chances are less than one percent (Table 4-26) those who think that their chances of getting sick are less than the randomly assigned risk, RISK1, varies significantly across the risk levels ($\chi^2$=36.58[6 df]). As the risk decreases from "one in a thousand" (RISK1=0.001) to "one in a million" (RISK1=0.000001) the percentage who think their chances are lower falls from 66% to 45% while those who think their chances are greater rises from 16% to 33%.

Between 41% and 48% of all respondents are very concerned about poor seafood handling practices. More than 60% of all respondents are very concerned about the freshness of seafood. Between 48% and 57% of all respondents are very concerned about diseases in fish. When the responses are pooled across state, respondents are significantly more concerned about the freshness of seafood relative to poor seafood handling practices ($\chi^2$=519[4 df]) and diseases in fish ($\chi^2$=453[4 df]).

*Perceptions about Pfiesteria*

More than 77% of Delaware and Maryland respondents and less than 70% of North Carolina and Virginia respondents had heard about Pfiesteria (Table 4-30). These differences are significant at the p=.01 level ($\chi^2$=18.15[3 df]). While most respondents had heard about Pfiesteria, they had difficulty when answering specific questions. The nonresponse rates were greater than 20% in Delaware, North Carolina, and Virginia and greater than 12% in Maryland for the two follow-up questions (PFIEST and OUTBREAK).

When attempting to define Pfiesteria, most respondents (who had heard about Pfiesteria), between 30% and 42%, stated that Pfiesteria is a toxic organism (Table 4-31 Other likely answers were a form of pollution (between 14% and 29%), a parasite in fish (between 22% and 29%), and a disease in fish (between 9% and 15%). Less than 3% thought that it is a predator that attacks fish. Differences across state are significant at the p=.05 level ($\chi^2$=23.33[12 df]).

Of those respondents who had heard of Pfiesteria, most (67% in Maryland, 73% in North Carolina, 84% in Maryland, and 91% in Virginia) thought that Pfiesteria outbreaks had occurred in their state during the past month (Table 4-32). These differences are significant at the p=.01 level ($\chi^2$=29.79[3 df]).

More than 79% of respondents who had heard about Pfiesteria are very concerned or somewhat concerned about Pfiesteria (Table 4-33). This level of concern is significantly greater than concern about poor seafood handling practices ($\chi^2$=212[4 df]), the freshness of seafood ($\chi^2$=133[4 df]), and diseases in fish ($\chi^2$=380[4 df]).

Less than 30% of Delaware, North Carolina, and Virginia residents and only 38% of Maryland residents had ever avoided eating seafood because of Pfiesteria outbreaks (Table 4-34). On the other hand, between 58% and 69% of residents would reduce the number of seafood meals that they would eat next month if a Pfiesteria outbreak occurred in their state during the next week (Table 4-35). Both of these differences are significant at the p=.05 level ($\chi^2$=8.05[3 df]) and ($\chi^2$=8.74[3 df]).

More than 70% of respondents either disagree or strongly disagree with the statement that it is safe to swim in coastal waters during a Pfiesteria outbreak (Table 4-36). About one-half of all respondents agree with the statement that it is safe to breathe the air around coastal waters during a Pfiesteria outbreak (Table 4-37). Between 77% and 94% of respondents either disagree or strongly disagree with the statement that it is safe to swim in coastal waters during a Pfiesteria outbreak (Table 4-38). The differences across state are significant at the p=.10 level ($\chi^2$=19.99[12 df]).

Between 58% and 67% of respondents either strongly agree or agree with the statement that it pollution from farms can cause Pfiesteria (Table 4-39) with differences across state significant at the p=.10 level ($\chi^2$=19.91[12 df]). Between 52% and 58% of respondents either strongly agree or agree with the statement that pollution from farms can cause Pfiesteria (Table 4-40). Between 20% and 28% of respondents are uncertain about either cause of Pfiesteria.

Data Summary: Second Survey

Between 61% and 69% of the respondents to the survey in each state read all of the information that was sent after the first survey (Table 4-41). Less than 14% in each state did not read it either very closely or somewhat closely (Table 4-42). Most respondents did not have the information with them at the time of the survey (Table 4-43). Fifty-nine percent, 77%, 65%, and 71% of those in Delaware, Maryland, North Carolina and Virginia did not have the information.

*Frequency of Seafood Consumption*

In contrast to the first survey, the frequency of seafood consumption does not vary significantly across state for respondents to the second survey (Table 4-44). Most respondents, between 40% and 50%, eat seafood about one or twice a month. Between 30% and 37% eat seafood about once a week. For respondents to the second survey, the frequency of seafood consumption is different from the first survey to the second (Table 4-45). Nineteen percent of respondents eat seafood more often while 17% eat seafood less often. These differences are significant at the p=.01 level ($\chi^2$=51.1[9 df]).

The average number of seafood meals eaten last month, NUMBER5, varies across state with almost 6 meals per month consumed in Maryland and only 3.54 meals per month consumed in North Carolina (Table 4-46). In each state, over 81% of the sample said that this represents seafood consumption in a typical month (TYPICAL2). For those non-typical month respondents, the number of seafood meals eaten in a typical month is less than 3 meals for Delaware in North Carolina, 5 meals in Maryland, and 3 meals in Virginia.

The number of meals consumed next month, NUMBER6, follows a pattern similar to NUMBER5. The difference in the number of seafood meals consumed last month and next month is not significantly different. The average difference in the number of seafood meals consumed last month and a typical month is 2.10 meals (n=145). This difference is significant at the p=.01 level according to the signed rank test.

Comparing the number of seafood meals consumed last month in the first and second survey, NUMBER1 and NUMBER5, the difference, .055, is significant at the p=.01 level (n=835). The difference in the hypothetical number of meals consumed next month across survey, NUMBER2 and NUMBER6, is .66 which is also significant at the .01 level (n=799).

*Perceptions about Pfiesteria*

Over 93% of respondents found the information about Pfiesteria very helpful or somewhat helpful (Table 4-47). In addition to the survey-related information, 39%, 20%, 31%, and 19% of respondents in Delaware, Maryland, North Carolina, and Virginia had heard or read something about Pfiesteria since the first survey (Table 4-48). In Delaware, 76% of this information was read in the newspaper while only 18% was seen on television (Table 4-49). In Maryland, 57% and 38% was obtained from newspapers and television. In North Carolina, most (47%) respondents obtained their information from television while 43% obtained it from newspapers. In Virginia, 56% received their information from newspapers and 44% received it from television or something else.

Sixty-two percent of Delaware respondents and between 52% and 55% of other respondents in each state think that Pfiesteria is a toxic organism (Table 4-50). Between 10% and 20% think that Pfiesteria is a form of pollution. Between 12% and 25% think that Pfiesteria is a parasite in fish. These differences are significant across state at the p=.05 level ($\chi^2$=24.40[12 df]). Of the 486 respondents who answered this question in both surveys, 29% answered correctly (those who answered "a toxic organism") in both surveys while 31% answered incorrectly in the first survey and correctly in the second survey. Seven percent of respondents answered correctly in the first survey and incorrectly in the second.

Sixty-four percent of North Carolina respondents and between 83% and 91% of all other respondents think that outbreaks of Pfiesteria occurred during the past month (Table 4-51). Of respondents to both surveys, over 57% did not think a fish kill had occurred during the past two months, over 12% thought that a fish kill had occurred during both of the past two months, and about 15% thought that a fish kill had occurred during one of past two months.

More than 77% of respondents are very concerned or somewhat concerned about Pfiesteria (Table 4-52). Less than 23% of Delaware, North Carolina, and Virginia residents and only 30% of Maryland residents had ever avoided eating seafood because of Pfiesteria outbreaks (Table 4-53). Over 49% of residents would reduce the number of seafood meals that they would eat next month if a Pfiesteria outbreak occurred in their state during the next week (Table 4-54).

Comparing respondents to the first and second survey, 17% are more concerned about Pfiesteria and 21% are less concerned during the second survey. Eleven percent of respondents said that they had avoided seafood after a fish kill during the first survey but then say that they had not avoided it in the second survey. Eight percent of respondents said that they had not avoided seafood after a fish kill but then say that they had avoided it in the second survey. During the first survey, 17% of respondents said that they would avoid seafood after a fish kill but then say that they would not avoid it in the second survey. Nine percent of respondents said that they would not avoid seafood after a fish kill but then say that they would avoid it in the second survey.

More than 70% of respondents either disagree or strongly disagree with the statement that it is safe to swim in coastal waters during a Pfiesteria outbreak (Table 4-55). Between 52% and 63% of all respondents agree with the statement that it is safe to breathe the air around coastal waters during a Pfiesteria outbreak (Table 4-56). Between 78% and 83% of respondents either disagree or strongly disagree with the statement that it is safe to swim in coastal waters during a Pfiesteria outbreak (Table 4-57).

Between 61% and 67% of respondents either strongly agree or agree with the statement that pollution from farms can cause Pfiesteria (Table 4-58). Between 63% and 67% of respondents either strongly agree or agree with the statement that pollution from factories can cause Pfiesteria (Table 4-59). Between 12% and 28% of respondents are uncertain about either cause of Pfiesteria.

There are significant differences in the frequencies of SWIM, BREATHE, EAT, FARM, and FACTORY when comparing responses from the first and second survey at the p=.10 level. Thirty percent, 19%, and 43% of respondents are more likely to agree that it is safe to swim, breathe and eat after a Pfiesteria outbreak while 25%, 21%, and 9% are less likely to agree with the statement. Twenty three percent and 22% are less likely to agree that farms and factories cause Pfiesteria while 13% and 14% are more likely to agree with the statement.

*Questions About the Fish Kill*

Between 88% and 94% of respondents consider the hypothetical fish kill to be either very realistic or somewhat realistic (Table 4-60).[5] However, between 75% and 85% of respondents consider the fish kill to be a major fish kill (Table 4-61). More respondents, 84%, who received the major fish kill scenario consider the fish kill to be major than those who received the minor scenario, 74% (Table 4-62)

Eight percent of the Delaware, Maryland, and Virginia sample eat seafood from the Pokomoke River, POKOMOKE, while 84% eat seafood from Maryland, MARYLAN (Table 4-63). Ten percent of the North Carolina sample eats seafood from the Neuse River, NEUSE, while 91% eats seafood from North Carolina, NORTHCA. The hypothetical fish kill would make between 84% and 91% think that seafood from the Pokomoke/Neuse River was not safe to eat.

*Seafood Safety and Demand after the Fish Kill*

After the hypothetical fish kill between 10% and 12% of respondents think that their chances of getting sick are very likely and between 26% and 36% think their chances are somewhat likely (Table 4-65). Compared to the first survey, 52% of respondents think their chances of getting sick are more likely while 8% think their chances are less likely. These differences are significant at the p=.01 level ($\chi^2$=63.43[9 df]).

Between 27% and 31% think that their chances of getting sick are greater than 1% while between 20% and 29% think their chances are about 1% (Table 4-66). Compared to the first survey, 38% more respondents think that their chances are greater than 1% and 14% more think their chances are less than 1%. These differences are significant at the p=.01 level ($\chi^2$=59.37[9 df]).

As the randomly assigned risk of getting sick decreases from "one in a thousand" (i.e., RISK2=0.001) to "one in a million" (i.e., RISK2=0.000001), the percent of respondents who think their chances of getting sick is less than RISK2 falls from 64% to 49% and the number that thinks their chance of getting sick is greater increases from 13% to 25% (Table 4-67). This variation is significant at the p=.05 level ($\chi^2$=20.51[9 df]).

The average number of seafood meals consumed after the fish kill ranges from 2.74 in North Carolina to 4.36 in Virginia (Table 4-68). This is a significantly lower number of seafood meals relative to the number consumed next month, NUMBER6, according to the signed rank test at the p=.01 level. There is no difference in the number of meals when the major and minor fish kill scenarios are compared. However, the

[5] After deleting two North Carolina residents who received the Maryland fish kill scenario, the second survey sample is n= 835.

number of meals consumed is significantly lower if the respondent perceives that the fish kill is major, FISHKILL=1, at the p=.01 level (t=2.84).

About 16% of the sample would change their eating habits in other ways. These 128 respondents provided 182 responses when asked about what else would change (Table 4-69). Most respondents, 53%, gave a response not listed in the survey, OTHER. Of the responses listed, 20% would eat more poultry, 15% would eat more meat, 13% would eat more vegetables, and 9% would eat fewer restaurant meals.

*Seafood Safety and Demand after the Seafood Inspection Program*

Most respondents, at least 96% in each state, think that the information about the seafood inspection program is very or somewhat clear (Table 4-70). After the hypothetical fish kill and with the seafood inspection program between 55% and 60% of respondents think that their chances of getting sick are not likely at all and between 21% and 26% think their chances are somewhat not likely (Table 4-71). Compared to the chances of getting sick after the fish kill, 9% of respondents think their chances of getting sick are more likely while 43% think their chances are less likely. These differences are significant at the p=.01 level ($\chi^2$=20.0[9 df]).

Between 8% and 13% think that their chances of getting sick are greater than 1% while between 65% and 71% think their chances are less than 1% (Table 4-72). Compared to the perceived risk after the fish kill, 5% more respondents think that their chances are greater than 1% and 34% more think their chances are less than 1%. These differences are significant at the p=.01 level ($\chi^2$=322[9 df]).

As the randomly assigned risk of getting sick decreases from “one in a thousand” (i.e., RISK2=0.001) to “one in a million” (i.e., RISK2=0.000001), the percent of respondents who think their chances of getting sick is less than RISK2 falls from 79% to 60% and the number that thinks their chance of getting sick is greater increases from 4% to 24% (Table 4-73). This variation is significant at the p=.05 level ($\chi^2$=32.73[9 df]).

The average number of seafood meals consumed after the fish kill and with the seafood inspection program ranges from 2.72 in North Carolina to 5.01 in Delaware (Table 4-74). This is a significantly higher number of seafood meals relative to the number consumed next month after the fish kill, NUMBER7, according to the signed rank test at the p=.01 level. With a seafood price increase associated with the inspection program the average number of meals falls to between 3.45 in North Carolina to 5.22 in Delaware. This is a significantly lower number of seafood meals relative to the number consumed next month according to the signed rank test at the p=.01 level. The number of meals falls, in general, as the seafood price increase (DP9) rises from $1 to $7 (Table 4-75)

*Willingness to Pay Questions*

Between 70% and 80% of respondents would vote for the seafood inspection program with higher prices in a national referendum (Table 4-76). The percentage of "for" votes declines from 85% to 64% as the seafood price increase rises from $1 to $7 (Table 4-77). This variation is significant at the p=.01 level ($\chi^2$=26.43[3]).

Between 64% and 72% of all respondents are very sure about their vote while between 20% and 24% are somewhat sure (Table 4-78). Eighty-one percent of respondents who answered "for" are very sure, 67% are somewhat sure, 46% are somewhat not sure, and 39% are not sure at all (Table 4-79).

Most respondents, over 84%, are very sure that they will vote in the November national election (Table 4-80). The number of "for" votes declines with respondent uncertainty about voting (Table 4-81). Eighty percent of respondents who say that they will vote for the program are very sure that they will vote in the November election, 86% are somewhat sure, 67% are somewhat not sure, and 59% are not sure at all. These differences are significant at the p=.05 level ($\chi^2$=9.39[3]).

*Debriefing Questions*

Between 76% and 79% of the respondents understood the hypothetical questions very well while between 19% and 27% understood them somewhat well (Table 4-82). Between 82% and 86% found the questions either somewhat easy or very easy to answer (Table 4-83). Between 96% and 99% were either somewhat sure or very sure about their answers to the hypothetical questions (Table 4-84). Between 72% and 77% requested a summary of the results of the study (Table 4-85).

## Chapter 5. Effects of Information on Qualitative Measures of Behavior, Attitudes and Risk Perceptions

In this chapter we consider variables measuring information, perceptions and qualitative behavior and risk. After describing the data, we describe the probit models used to estimate the factors that affect information, behavior, and perceptions. We consider the role of cultural models of Pfiesteria as in Kempton and Falk (2000). We then focus on the effects of brochure and counter information on knowledge about Pfiesteria, past and future seafood consumption behavior, concern about Pfiesteria and other issues, perceptions about Pfiesteria, and perceived seafood risk associated with fish kills and a seafood inspection program.

### The Data

The measures of knowledge and behavior are derived from the variables PFIEST, OUTBREAK, AVOID, and REDUCE. Respondents were asked the closed-ended question "to the best of your knowledge, would you say that Pfiesteria is … [read categories]?" The variable PFIEST is recoded to be equal to one if the respondent correctly answered "a toxic organism" and zero if the respondent incorrectly answered "a form of pollution," "a disease in fish," "a predator that attacks fish," or "a parasite in fish." In the first survey the next question began with the phrase "Pfiesteria is a potentially toxic organism." The Pfiesteria brochure contained the same phrase in its definition of Pfiesteria. The second survey asked the same knowledge question again. In this analysis we use only respondents who answered both questions (n=485). Thirty-six percent of respondents to the first survey answered correctly. Sixty-one percent of the respondents in the second survey answered correctly. The difference in response across surveys is significant at the p=.01 level.

In both surveys following the Pfiesteria definition, respondents were asked the knowledge question: "… have outbreaks of Pfiesteria occurred in [state] during the past month?" Considering respondents who answered both questions (n=468), 28% of respondents in both surveys thought that an outbreak of Pfiesteria had occurred.

Behavioral questions include AVOID and REDUCE. The percentage of respondents who have ever avoided eating seafood because of Pfiesteria is twenty-eight and twenty-five in the first and second surveys (n=641). Respondents were then asked whether they would eat fewer meals next month if a Pfiesteria outbreak occurred in their state the next week. Fifty-nine percent and 52% of respondents answered yes in the first and second surveys (n=614).

Several questions about seafood safety concern were asked in the first survey: concern about poor seafood handling practices (HANDLING), the freshness of seafood (FRESH), and diseases in fish (DISEASE). In both surveys after the seafood knowledge questions, respondent concern about Pfiesteria (CONCERN) is also asked. For HANDLING (n=634), FRESH (n=645), and DISEASE (n=635) we only consider respondents who also answered the Pfiesteria concern question (n=647). The variables are re-coded so that they are increasing in concern: 0 is not concerned, 1 is somewhat concerned, and 2 is very concerned. The average concern level is 1.25, 1.49 and 1.37 for HANDLING, FRESH, and DISEASE. The average concern level for Pfiesteria in the first survey and second surveys are in the same range at 1.27 and 1.22.

Several statements about Pfiesteria were then read in both surveys. Respondents were asked if they strongly agree, agree, disagree, strongly disagree, or are uncertain about whether it is safe to swim in coastal waters during a Pfiesteria outbreak (SWIM), breathe the air around coastal waters during a Pfiesteria outbreak (BREATHE) and eat seafood from an area where a Pfiesteria outbreak has happened (EAT). Two other statements about the source of Pfiesteria are also presented: pollution from farms (or factories) can cause Pfiesteria outbreaks (FARMS, FACTORY). Only those respondents who answered the same question in both surveys are included.

These variables are re-coded so that they are increasing in agreement: 0 is strongly disagree, 1 is disagree, 2 is uncertain, 3 is agree, and 4 is strongly agree. Due to the low frequency of some of the responses, two categories for each variable are combined so that the range is zero to three. Only 3%, 1%, and 1.7% of respondents strongly disagreed with the statements about breathing air around coastal waters and farms and factories as the source of Pfiesteria outbreaks. These responses are combined with the disagree category. Only 2.7% and 1.3% of respondents strongly agreed with the statements about swimming in coastal waters during Pfiesteria outbreaks and eating seafood from coastal waters after Pfiesteria outbreaks. These responses are combined with the agree category. The average response to SWIM, BREATHE, and EAT is .87, 1.44, and .82 in the first survey and 1.21, 1.41, and 1.02 in the second. The average response to FARMS and FACTORY is 1.65 and 1.57 in the first survey and 1.57 and 1.51 in the second.

The likelihood of getting sick from eating seafood meals (CHANCE) is measured with a four level scale variable: 0 is not likely, 1 is somewhat not likely, 2 is somewhat likely, and 3 is very likely. Three observations for each respondent are included. The first is the baseline chance of sickness from the first survey. The second is the chance of sickness after the hypothetical fish kill. The third is the chance of sickness with the seafood inspection program. Only those respondents who answered each question are included. The average value of the dependent variable is .41, 1.20, and .65 in the first, second, and third scenarios (n=790).

The primary independent variables of interest are dummy variables for whether the respondent received the Pfiesteria brochure (PFIEBROC=1) and counter information insert (COUNTER=1). Control variables are demographics and state dummy variables. Summary statistics for these variables are presented in Table 5-1 for all respondents who responded to both surveys (n=833). The average number of years lived in the state of residence is 31. The average household size is 2.68 and average number of children is .70. The average number of years of schooling is 14.5 and age is 47. Thirty-five percent of the sample is male and 77% is white. Thirty-three percent live in an urban county. The average annual household income is $52,700. A little more than 10% of the sample lives in Delaware, Maryland (including DC), or Virginia.

Econometric Models

We estimate the factors that affect the dichotomous knowledge and behavior variables using the probit model (Greene, 1997)

$$(5.1) \qquad y_i^* = b' X_i + e_i$$

where $y_i^*$ is an unobserved latent variable, $i = 1, \ldots, n$, $b$ is a vector of parameters, $X$ is a vector of independent variables and $e_i$ is distributed normally with zero mean and variance equal to $s^2$. The latent dependent variable is measured by the dummy dependent variable

$$(5.2) \qquad \begin{aligned} y &= 1 \quad if\ y^* > 0 \\ y &= 0 \quad if\ y^* \leq 0 \end{aligned}$$

The probit model estimates the probability of the outcome variable using the normal distribution

$$(5.3) \qquad \Pi(y = 1) = \Phi(b' X_i)$$

where $\Phi(.)$ is the standard normal distribution function.

Since we have multiple observations on several of the variables (i.e., first and second survey measures) we treat the data as a panel. The random effects probit model is a panel data extension of the simple probit model where the error term accounts for the correlation across respondents

$$(5.4) \qquad y_{it}^* = b' X_{it} + e_{it}$$

where $t = 1, \ldots, T$ time periods (i.e., observations for each respondent). The error term, $e_{it}$, is distributed normally and is composed of two parts, $v_{it} + u_i$, where $v_{it}$ is the normally distributed random error with mean zero and variance, $s_v^2$, $u_i$ is the error common to each individual with mean zero and variance, $s_u^2$, and $s_e^2 = s_v^2 + s_u^2$. The correlation in error terms, $r = s_u^2/s_e^2$, is increasing in the contribution of the individual error to the total error and is a measure of the appropriateness of the random effects specification.

We estimate the factors that affect the ordinal concern, perception, and risk variables using the ordered probit model (Greene, 1997). Assume that there are $m$ choices in the survey question and the dependent variable is coded $y = 0, \ldots, m-1$. The ordered probit model uses the same structure as the basic probit model with $m-2$ additional censoring parameters

$$
\begin{aligned}
&y = 0 \quad if\ y^* \leq 0 \\
&y = 1 \quad if\ 0 < y^* \leq m_1 \\
&y = 2 \quad if\ m_1 < y^* \leq m_2 \\
&\ \ \vdots \\
&y = m - 1 \quad if\ m_{m-1} \leq y^*
\end{aligned}
\tag{5.5}
$$

where the $m_y$'s are parameters to be estimated and $m_y > 0$. The ordered probit model estimates the probability of the outcome variable using the normal distribution

$$
\begin{aligned}
&\Pi(y = 0) = \Phi(-b' X_i) \\
&\Pi(y = 1) = \Phi(m_1 - b' X_i) - \Phi(-b' X_i) \\
&\Pi(y = 2) = \Phi(m_2 - b' X_i) - \Phi(m_1 - b' X_i) \\
&\ \ \vdots \\
&\Pi(y = m - 1) = 1 - \Phi(m_{m-1} - b' X_i)
\end{aligned}
\tag{5.6}
$$

The random effects ordered probit model extends the ordered probit model to the case of panel data. The probit models are estimated using the LIMDEP statistical software (Greene, 1995).

<u>Cultural Models</u>

We first perform an analysis similar to Kempton and Falk (2000) who categorize the cultural models of Pfiesteria, as defined by the "what is Pfiesteria" question, against behavior and perceptions related to Pfiesteria. As defined by Kempton and Falk, "a cultural model is a simplified way of understanding a complex system, shared by members of a culture." Kempton and Falk find that those who think of Pfiesteria as a pollutant or toxin and those who think of Pfiesteria as a disease or parasite in fish answered questions in similar ways. We find that only those who think of Pfiesteria as a disease or parasite in fish answered questions in similar ways. This divergence may be because we changed one answer category from Kempton and Falk's "a toxin or poison" to that which is consistent with the USEPA's (2001) definition of Pfiesteria as "a toxic organism." Similarly, we find only a few respondents consider Pfiesteria as "a predator that attacks fish." In contrast to Kempton and Falk, we do not consider this response in our analysis.

We compare the number of respondents who reported having avoided eating seafood in the past or who would avoid eating seafood in the future in response to Pfiesteria-related fish kills (Table 5-2). We find no differences across cultural model in the percentage of respondents who have changed past eating habits in either the first and second surveys (the columns in Table 5-2). In the first survey those respondents who consider Pfiesteria to be a disease or a parasite in fish are most likely to reduce the amount of seafood they would eat in the month following a Pfiesteria-related fish kill. In the second survey those who think that Pfiesteria is a toxic organism are more likely to reduce the amount of seafood they would eat. The differences in the first and second surveys are significant at the p = .01 level.

Large differences in the percentage of those who would engage in the behaviors are found when comparing the first and second surveys (the rows in Table 5-2). In the second survey, those who believe that Pfiesteria is a toxic organism are more likely to avoid seafood consumption either in the past or the future. As suggested by Kempton and Falk, this result indicates that the cultural model is an important determinant of behavior. Information that alters the cultural model is a potentially important strategy when addressing Pfiesteria-related perceptions about seafood safety. In this case however, the true definition of Pfiesteria is related to the unintended behavioral response.

Next we compare the percentage of respondents who are very concerned about Pfiesteria, disaggregated by cultural model, across the first and second surveys (Table 5-3). In the second survey, respondents who consider Pfiesteria to be a toxic organism are most concerned about Pfiesteria. Those who consider Pfiesteria to be a disease or parasite are the least concerned. These differences are significant at the p=.05 level.

A similar analysis is conducted comparing the percentage of respondents who strongly agree or agree with the statements that it is safe to swim in coastal waters, breathe the air around coastal waters, or eat seafood from an area where a Pfiesteria outbreak has happened. No differences in agreement across cultural model were found for either of these behaviors. This result may be primarily due to the small number of respondents who agreed with the statements.

<u>Knowledge and Behavior</u>

We next consider how the brochure and counter information changes the correct response to the cultural model of Pfiesteria (PFIEST, after its recoding to a dummy dependent variable) and belief that a Pfiesteria outbreak had occurred during the past month (OUTBREAK) (Table 5-4). All models are weighted to account for the sample stratification. The results from the random effects probit model indicate that those respondents who received the Pfiesteria brochure (PFIEBROC) are more likely to consider Pfiesteria to be “a toxic organism” relative to the other choices. This response is also more likely for households with children and higher education levels. Maryland residents are less likely to consider Pfiesteria a toxic organism.

Respondents who received the Pfiesteria brochure are less likely to believe that Pfiesteria outbreaks had occurred in the state. Men, whites, and Maryland and Virginia residents are less likely to believe that a Pfiesteria outbreak occurred. Those with higher incomes are more likely to think that Pfiesteria outbreaks had occurred.

We find that the brochure information has no statistically significant effect on behavior (Table 5-4). Neither the brochure nor the counter information has any effect on past behavior, as expected. Whites, males, those with children and those who live in urban areas are less likely to have avoided eating seafood because of Pfiesteria.

Consistent with anecdotal evidence, Maryland residents are more likely to report that they have avoided eating seafood in the past due to Pfiesteria. Tenure in the state of residence is also related to avoidance of seafood due to Pfiesteria.

The counter information has a negative and statistically significant effect (p=.10) on whether the respondent would reduce seafood consumption because of a Pfiesteria-related fish kill. Whites, males, those with higher incomes, and Delaware and Maryland residents are less likely to reduce their future consumption of seafood in response to Pfiesteria-related fish kills. Older respondents are more likely to reduce their seafood consumption due to a fish kill.

Each of the models in Table 5-4 was split by the North Carolina samples and Delaware, Maryland and Virginia samples. In combination with a pooled model without state dummy variables the likelihood ratio statistic for the equality of coefficient vectors is constructed

$$\chi^2[d.f. = k] = -2\ [(LL_{NC} + LL_{DE\text{-}MD\text{-}VA}) - LL_{Pooled}\ ]$$

where the test statistic is distributed chi-square with the degrees of freedom (d.f.) equal to the number of constraints (k) imposed in the pooled model (i.e., the number of parameters in the model), and LL is the log-likelihood of the regression model.

No differences in the coefficient vectors are found for the knowledge variables. These results indicate that the determinants of knowledge for the North Carolina sample are similar to those of the Delaware, Maryland, and Virginia sample. Statistically significant differences in the samples are found for avoidance behavior ($\chi^2$=72.53[13 d.f.]). The counter information reduces the likelihood that North Carolina residents believe that a Pfiesteria-related fish kill has occurred but has no effect for Delaware, Maryland, and Virginia residents. There are also some differences in the effects of demographic variables.

Concern about Seafood Safety

The determinants of the concern for seafood safety are presented next (Table 5-5). All models are weighted to account for the sample stratification. The results of the random effects ordered probit model for concern about the effects of Pfiesteria on seafood safety (CONCERN) shows that the Pfiesteria brochure had no statistically significant effect. The counter information had a negative effect on concern (p=.10). Those with more education and whites are less concerned. Those with children, who are older, and with more tenure in the state are more concerned.

The random effects ordered probit model for concern was split by the North Carolina sample and Delaware, Maryland, and Virginia fish kill samples. Statistically significant differences in the coefficient vectors are found ($\chi^2$=78.57[13 d.f.]). The Pfiesteria brochure increases concern and the counter information decreases concern for North Carolina residents. There is no information effect on the Delaware, Maryland, and

Virginia sample. In the North Carolina model, age increases concern and whites and urban respondents are less concerned. In the Delaware, Maryland, and Virginia model, whites and those with more education are less concerned.

For comparison, we present the ordered probit results from the first survey for concern about Pfiesteria and seafood and the general concern about seafood safety: seafood handling practices, the freshness of seafood and disease in fish (Table 5-6). The later three variables were not collected during the second survey due to time constraints. Overall, we find contrasting results for concern about Pfiesteria and general seafood safety. The only similar result is that household size decreases concern about Pfiesteria and the freshness of seafood.

Tenure in the state increases concern about seafood safety and Pfiesteria but decreases the measures of general concern about seafood safety. Those with children are more concerned about Pfiesteria but not the other issues. Education decreases concern about Pfiesteria but increases concern about handling and disease. Age increases concern about Pfiesteria. Males are more concerned about seafood freshness and disease but not Pfiesteria. Whites are significantly less concerned about Pfiesteria and seafood but more concerned about general seafood safety than non-whites. Those who are older are more concerned about Pfiesteria but not the other issues. Those with more income are concerned about freshness. Those with less income and those living in urban counties are less concerned about diseases in fish.

Attitudes about Pfiesteria

The random effects ordered probit models for perceptions about the safety of coastal waters and the source of Pfiesteria are presented in Table 5-7. All models are weighted to account for the sample stratification. The Pfiesteria brochure includes a short paragraph about the cause and contributing factors of Pfiesteria and potential human health problems from Pfiesteria. The counter information insert includes a description of seafood safety and the safety of swimming and boating in coastal waters but does not mention the source of Pfiesteria. Therefore we expect that the Pfiesteria brochure might affect perceptions about the safety of swimming in coastal waters, breathing air near coastal waters, eating seafood, and whether farms or factories contribute to Pfiesteria. We also expect that the counter information might affect perceptions about the safety of swimming in coastal waters, breathing air near coastal waters, and eating seafood. We make no predictions about the directions of the expected effects since the direction depends on baseline perceptions.

The counter information insert has a positive effect on the likelihood of agreement with the statements that it is safe to swim in coastal waters during a Pfiesteria outbreak and safe to eat seafood. The Pfiesteria brochure has positive effects on the likelihood of agreement with the statements that farms and factories are the cause of Pfiesteria. Surprisingly, the counter information has negative effects on agreement with the statements about farms and factories.

Other variables are important in explaining these perceptions. Tenure in the state decreases the likelihood of agreement with the safe swimming statement. Men are more likely to agree that it is safe to swim. Older respondents and those with more income are less likely to agree with the safe breathing statement. Men, whites, and urban and Virginia residents are more likely to agree. Whites and urban residents are more likely to agree that it is safe to eat seafood. Length of tenure in the state increases agreement with the statements that farms and factories cause Pfiesteria. Household size and age decreases agreement with the farm statement. The number of children increases agreement with the farm statement. Men, whites, urban and Virginia residents are less likely to agree with the statement that factories cause Pfiesteria.

Each of the models in Table 5-7 was also split by the North Carolina and Maryland fish kill samples. No differences in the coefficient vectors are found except for the EAT model ($\chi^2$=49.96[13 d.f.]). In contrast to the model in Table 5-6, the effect of the Pfiesteria brochure on agreement is positive for North Carolina residents. The counter information has no effect in the split sample models.

<u>Perceived Seafood Risk</u>

The random effects probit models measuring the effects of information on the perceived likelihood of getting sick from eating seafood (CHANCE) are presented in Table 5-8. All models are weighted to account for the sample stratification. In these models we include dummy variables for the hypothetical major (MAJOR) and minor (MINOR) fish kills in addition to the variables in the previous models. We present both pooled and split-sample models because the coefficient vectors are significantly different at the p=.01 level ($\chi^2$=100.46 [df=17]).

In initial models we also included the number of seafood meals eaten as an independent variable. The number of seafood meals from the relevant scenario is matched to the risk perception scenario. Since the perceived risk questions were conditioned on the number of seafood meals eaten under the different scenarios, the likelihood of getting sick might be expected to increase with the number of seafood meals.

However, we have no ex-ante expectations about the effect of the quantity of meals on the perceived risk. The effect could also be negative; respondents who eat more meals perceive a lower risk. In other words, respondents who perceive a low risk may eat more seafood meals. In this case the causality is reversed and the number of meals is not an appropriate explanatory variable in the risk perception model. In fact we find that the number of seafood meals has a negative effect on perceived risk. This result supports the notion that the respondents who perceive low risk from eating seafood eat more seafood meals. This suggests that inclusion of the number of seafood meals variable in this model is inappropriate.[6]

In the pooled model, both the major and minor fish kill scenarios have positive effects on the perceived likelihood of getting sick from eating seafood. The size of the coefficients on MINOR and MAJOR are not statistically different suggesting that it is the fish kill even, not the magnitude of the event, that matters in risk perception. The Pfiesteria brochure has a negative effect on perceived risk. In the North Carolina model the counter information has a negative effect on perceived risk (p=.10).

Other results in the pooled model are that household size increases perceived risk. Households with children (holding constant household size), males, whites and those with higher incomes have lower perceived risk. In the North Carolina model, household size increases perceived risk. Households with children, whites and those with higher perceive lower risks. In the North Carolina model males, whites, and those with higher incomes perceive lower risks. In the Delaware, Maryland, and Virginia model perceived risk increases with household size and decreases with children, income, and for white respondents.

Conclusions

In this chapter we present empirical results focused on the effects of information in the Pfiesteria brochure and the counter information insert on behavior, attitudes about Pfiesteria and risk perception. In general, the counter information is more successful in allaying fears that seafood is not safe during periods with Pfiesteria-related fish kills. The Pfiesteria brochure increases concern about seafood safety for North Carolina residents. For the full sample the Pfiesteria brochure reduces perceived seafood risk.

Respondents who received the counter information are less likely to reduce seafood consumption because of a Pfiesteria-related fish kill, have less concern about seafood safety (North Carolina residents only), and are more likely to agree that it is safe to swim in coastal waters during a Pfiesteria outbreak and safe to eat seafood. In contrast to these results, counter information has a negative effect on perceived seafood risk for Delaware, Maryland, and Virginia residents.

Other effects of the brochure and counter information are more general. Respondents who received the brochure are more likely to consider Pfiesteria to be “a toxic organism” relative to the other cultural models and less likely to believe that Pfiesteria outbreaks had occurred in their state during the past month. The Pfiesteria brochure increases the likelihood of agreement with the statements that farms and factories are the cause of Pfiesteria. The counter information insert reduces the likelihood that North Carolina residents believe that a Pfiesteria-related fish kill had occurred in their state in the past month. The counter information decreases the likelihood that

[6] In fact, after dropping the number of seafood meals from the model the log-likelihood value increased indicating an improvement in the model.

respondents agree with the statements about farms and factories causing Pfiesteria.

References

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United States Environmental Protection Agency, "What You Should Know About *Pfiesteria piscicida*," http://www.epa.gov/owow/estuaries/pfiesteria/fact.html, January 23, 2001.

## Chapter 6. Quantitative Effects of Information on Risk Perceptions

In this chapter, we operationalize the theoretical models of Chapter 2 to estimate the value of risk reductions as perceived by seafood consumers, and measure the impact of the various information treatments (brochures and counter information) on perceived risks of seafood consumption. We first provide an overview of the conceptual model of risk formulation as described in Chapter 2. We then briefly describe the relevant portions of the survey as they apply to quantitative risk perceptions on the part of seafood consumers. Finally, we provide estimates of quantitative risk perception models that include the various information treatments. For comparison we highlight similarities and differences between the quantitative risk models of this chapter, and the qualitative risk models of Chapter 5.

### The Conceptual Model

Chapter 2 described in detail, the theory of risk and demand as it applies to Pfiesteria and seafood consumption. Here we highlight some of the main ideas of chapter 2 as they apply to the estimation of quantitative risk assessment models. We conceptualize Pfiesteria as a factor affecting perceptions of seafood safety that affects perceived health risk. Consumer seafood demand is a function of perceived health risk. Consider the utility, U, of a seafood consumer

(6.1) $$u = u(x, h, z)$$

where *u(.)* is the utility function, $x$ is the quantity of seafood meals, $h$ is health, and $z$ is a composite commodity of all other goods. Utility is increasing in meals, health and the composite commodity. Seafood meals are differentiated by quality, $q$,

(6.2) $$x = x(q)$$

Seafood consumption is increasing in quality that incorporates grades of seafood and consumer perceptions about quality (i.e., tastes).

Consumer health is produced according to a production function that includes averting, $a$, and defensive, $d$, behaviors as inputs

(6.3) $$h = h(a, d)$$

Averting behaviors include preparing and cooking seafood properly, or reducing seafood consumption when faced with negative information about seafood safety. Defensive behaviors include trips to the doctor after a seafood-related illness.

The perceived health risk from eating seafood is the subjective probability of getting sick from seafood meals, $r$, (6.4) $r = r(s)$

where s is a vector of $S$ perceived seafood safety variables, and individual attributes: $s = s(s_1,...,s_S)$ . Safety is the degree to which seafood consumption can lead to diminished health. The effect of seafood safety on risk is negative, $\frac{\partial r}{\partial s} < 0$ . Any information that leads to a decrease in perceived seafood safety, such as fish kills and problems with government seafood inspection programs, will lead to increased risk. The consumption of seafood meals leads to a positive probability of getting sick and may also be included in the s vector. Therefore, the perceived health risk may be a function of the number of seafood meals consumed.

The *ex ante* utility function is

(6.5) $\tilde{u} = r(s)\cdot u(x,h',z) + (1 - r(s))\cdot u(x,h^o,z)$.

where $h^o$ as (current) healthy and $h'$ as unhealthy (sick) states of the world. The consumer faces the budget constraint

(6.6) $y = px + mh + z$

where $p$ is the price of seafood, $m$ is the full cost of health and the price of the composite commodity is normalized at one. The full cost of health depends on averting and defensive expenditures and is assumed constant.

The consumer's problem is to maximize expected utility subject to the budget constraint resulting in the *ex ante* indirect utility function

(6.7) $$\tilde{v}(p,r(s),y) = \text{Max } [r(s)\cdot u(x,h',z) + (1-r(s))\cdot u(x,h^o,z)] \text{ s.t. } y = px + h + z$$

The indirect utility function is decreasing in price and risk and increasing in income. By Roy's identity, the uncompensated demand for seafood is

(6.8) $$-\frac{\partial\tilde{v}/\partial p}{\partial\tilde{v}/\partial y} = x(p,r(s),y).$$

Two properties of the seafood demand function are

(6.9) $$\frac{\partial x}{\partial p} < 0, \frac{\partial x}{\partial r} < 0.$$

Seafood consumption is decreasing in price and risk. The effect of seafood safety on demand involves the indirect effect

$$(6.10)\quad \frac{\partial x}{\partial s} = \frac{\partial x}{\partial r}\frac{\partial r}{\partial s} > 0 .$$

The marginal effect of safety is positive because the effect of risk on consumption is negative, $\frac{\partial x}{\partial r} < 0$, and the effect of safety on risk is negative, $\frac{\partial r}{\partial s} < 0$. The remainder of this chapter focuses on estimating the effects of information about seafood safety on the perceived risk of illness from eating seafood.

The Survey

Chapter 3 provides details on the full survey. Here we highlight the portions of the survey that deal with quantitative risk assessment and information treatments. For a full description of the survey, we refer the reader to Chapter 3 and the appendices. The survey began with an initial screener serving two purposes: 1) elicit baseline qualitative and quantitative risk perception about seafood consumption, and 2) recruit participants for the follow-up phone survey. About one week after respondents agreed to participate in the second telephone survey an information brochure was mailed. The information mail-out consists of four parts. The major part is the Pfiesteria brochure titled "What you should know about Pfiesteria" which was based on the brochure published by the U.S. Environmental Protection Agency's Office of Water titled "What you should know about Pfiesteria Piscicida." The brochure and the "counter information" insert followed the same format with the same headings and edited text. The brochure also consisted of "fish kill information," "seafood inspection program," and "hypothetical fish kill" inserts. The brochures were full color and included contact information for more information.

Each section of the Pfiesteria brochure includes one or two short paragraphs. Full color photographs accompany the text. The first page included three sections. The first section of the brochure began with a simple definition of Pfiesteria. The second section explains that Pfiesteria stuns with released toxics and that the toxins are believed to cause sores on fish. The third section states that toxic outbreaks of Pfiesteria are short but Pfiesteria-associated fish kills can last for days or weeks. The second page included three sections. The fourth section of the brochure describes other sources of fish kills and sores. The fifth section then describes more fully where Pfiesteria has and has not been found with an illustrative map. The sixth section emphasizes the scientific uncertainty about Pfiesteria by using qualifiers to describe each source of outbreaks. The back page of the brochure contained three sections. The seventh section of the brochure discusses health effects. The eighth section stated that brown and red tides and Pfiesteria are types of harmful algal blooms. The ninth section provided state Pfiesteria hotline numbers.

In the hypothetical fish kill insert, respondents in North Carolina were asked to consider a hypothetical press release about fish kill in the Neuse River near New Bern, NC. Respondents in Delaware, Maryland, and Virginia were asked to consider a hypothetical fish kill in the Pokomoke River on the eastern shore of Maryland. There were major and minor versions for the hypothetical fish kills. The major fish kill is described to affect approximately 300,000 Menhaden, 10,000 Croaker and 5,000 Flounder. The minor fish kill is described to affect approximately 10,000 Menhaden.

Another insert provided further information about fish kills and a proposed mandatory seafood inspection program. The fish kill information included a bar chart defining major and minor fish kills. The other side of the insert proposed a mandatory inspection program by the U.S. Department of Commerce (USDC) instead of the voluntary inspection services of seafood producers and processors (under the authority of the Agricultural Marketing Act of 1964).

The counter information is intended to enforce the notion of the safety of seafood. The information states "YES. In general it IS safe to eat seafood". It further reports that there has never been a case of illness from eating finfish and shellfish exposed to Pfiesteria and that swimming and boating and other recreational activities in costal waters are generally safe. Finally, it has information on what is being done about Pfiesteria by the collaboration of state, federal, and local government and academic institutions. The expectation is that respondents who received this counter information are less likely to worry about seafood safety.

There are twelve sub-samples based on the experimental design of the information treatments (Table 6-1). Among the target sample size of 2000 seafood eaters in both North Carolina and the rest of the sample, 80% were to receive the Pfiesteria brochure and 40% of these were to receive the counter information. Twenty-percent were to receive neither source of information.

*The Questionnaires*

The first telephone interview collected information on seafood consumption patterns and costs, revealed and stated seafood demand under a variety of pricing scenarios, seafood health risk, attitudes and perceptions about seafood and Pfiesteria, and socioeconomic information. A series of questions were asked to gather qualitative and quantitative perceived risk information. The qualitative risk question is: "To get a better idea of how safe you think you are from eating seafood, consider the seafood meals you expect to eat next month. What do you think are your chances of getting sick from eating these meals? Do you think they are very likely, somewhat likely, somewhat not likely, or not likely at all?"

The quantitative risk question was asked immediately after the qualitative question and presents a dichotomous choice with a follow-up: "Do you think your chances are greater or less than 1%?" The interviewers accepted the potential answer categories "more," "less," or "about 1%." Respondents who perceive that the chance of getting sick is less than one percent were asked a follow-up question with a lower risk amount: "This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in D?" The denominator D took on one of four possible values: 1000, 10,000, 100,000, or 1,000,000.

Respondents answered a set of four questions about the number of seafood meals they consumed each month. They were first asked how many seafood meals they ate the previous month (revealed behavior) and how many they would eat the next month (stated behavior). They were asked how many seafood meals they would eat next month if seafood meal prices went up by one of four different price versions while all other food prices remain the same. Also they were asked how many seafood meals they would eat next month if price went down by one of four different prices while all other food prices remain the same.

The second (follow-up) interview was designed to collect information on seafood demand, seafood health risk, and attitudes about seafood and Pfiesteria. Most of the questions were identical or similar to questions asked in the first survey. The main purpose of these questions is to determine if seafood demand, perceived health risk and attitudes about Pfiesteria change after receiving the information.

Respondents were asked to assess their perceived risk of eating seafood under two different scenarios. First, they were asked for their qualitative and quantitative risk assessment after the hypothetical fish kill. Then they were asked for their qualitative and quantitative risk perceptions after the mandatory seafood inspection program is implemented. The qualitative and quantitative risk questions are the same as those in the first interview.

Empirical Models of Risk Perception

Now we turn to the task of developing an estimable model of quantitative risk perception based on the theory of Chapter 2, and the survey format described in Chapter 3. Let $r$ be the risk of getting sick from eating seafood in a typical month. In general:

(6.11) $$r = f(s, e)$$

where $s$ is a vector of socio-demographic, attitudinal variables and information variables, and $e$ is an unobservable error term assumed to be mean zero. The function $f(.)$ is bound between zero and 1.

If the probability of getting sick per seafood meal ($\pi$) is independent of all other seafood meals eaten then the probability of getting sick in a given month is the binomial probability:

(6.12) $$r = p^{x}(1-p)^{T-x}$$

where $p = g(s)$ is the per seafood meal probability of illness and $T$ is the total number of meals eaten per month. Because unobservable effects (such as poor food handling practices at home, in frequented stores, or restaurants) might introduce interdependence between the probabilities of illness from one meal to the next, we will rely on the more general formulation of the monthly probability of illness.

In general, the monthly probability of illness is at the very least unobservable to the researcher, and in many cases uncertain to the respondent. As described previously, to address this uncertainty, we ask respondents two types of risk questions: qualitative and quantitative.

The qualitative risk questions asked respondents their likelihood of getting sick next month from eating seafood on a four category scale: very likely=3, somewhat likely=2, somewhat not likely=1, or not likely at all=0. In chapter 5, we estimate the factors that affect the qualitative risk perception using an ordered probit model (Greene, 1997). For comparison to subsequent models, we refer the reader to chapter 5. The quantitative risk question asks respondents a series of dichotomous risk response questions of the stylized form: Do you think your chances of getting sick (in a typical month) are greater or less than z%? Suppose:

$$(6.13) \quad r = f(s,e) = \frac{1}{1+e^{sb+e}}$$

where s is a vector of individual specific covariates that may include socio-demographic variables, attitudinal and perception of illness and safety variables, and information treatments. The probability of $r \geq z$ is then:

$$(6.14) \quad \begin{aligned} P(r \geq z) &= P\left(\frac{1}{1+e^{sb+e}} \geq z\right) \\ &= P\left(e \leq \ln\left(\frac{1}{z}-1\right) - sb\right) \end{aligned}$$

If we assume that $e \sim N(0, s^2)$ then:

$$(6.15) \quad \begin{aligned} P(r \geq z) &= P\left(\frac{e}{s} \leq \frac{\ln\left(\frac{1}{z}-1\right)}{s} - s\frac{b}{s}\right) \\ &= \Phi\left(\frac{\ln\left(\frac{1}{z}-1\right)}{s} - s\frac{b}{s}\right) \end{aligned}$$

This should be recognized as the standard probit probability from a dichotomous choice survey. The risk perception function can be estimated as a probit model with covariate vector $s^* = \left\{ \ln\left(\frac{1}{z} - 1\right), s \right\}$ and estimated parameter vector $b^* = \left\{ \frac{1}{s}, -\frac{b}{s} \right\}$.

The quantitative choice question was asked of respondents three different times. The first survey elicits the baseline quantitative risk assessment. If the respondent states that perceived risk is greater than .01 (the amount offered to all respondents), then the quantitative risk assessment ended. If the respondent perceived risk to be less than 1% then they were randomly assigned a follow-up probability (.001, .0001, .00001, .000001). The same procedure was followed twice on the follow-up survey: after the fish kill hypothetical fish kill, but before they were told the seafood inspection program (SIP) would be implemented, once after the seafood inspection program was implemented.

To assess the individual responses to the various information treatments the three versions of the quantitative risk perception questions are combined into a single random effects probit panel model.

(6.16) $Y_{it} = f' X + e_{it}$

where $Y_{it}$ = 1 if household *i, i = 1, … , n*, chooses "greater than" and 0 if "less than" or "about z%" in time *t = 1, … , 6*, $f$ is a vector of parameters, and *X* is a vector of independent variables. Each respondent has between one and six responses to the risk perception questions yielding unbalanced panels. A respondent that responded that perceived risk is greater than 1% and did not participate in the second survey would have only one response. A respondent that answered that the risk is less than or equal to 1% for all three questions will have 6 responses (3 first responses and 3 follow-ups). It is assumed that each individual has an error term that carries across all six potential responses, and a random effect that is specific to each of the six responses. This random effect is assumed to be distributed the same across all responses.

Results: Quantitative Risk

Table 6-2 reports the response proportions for the three quantitative risk dichotomous choice questions. Focusing only on the first response to the quantitative risk questions, greater than 1%, it appears that the perceived risks (greater than 1%) of getting sick from seafood meals after the fish kill (but before the seafood inspection program) increase from 38% to 55%. Further, the seafood inspection program decreases the proportion of respondents with perceived risk greater than 1% (from 55% to 31%). The follow-up ($2^{nd}$) response does not provide a clear pattern. Because these responses are conditional on the first response it is not clear how the pattern will vary across versions of the risk question. We do expect the percent of "greater than" responses to be higher, the lower the offered risk on the follow-up question. This pattern is clear for the question from the second survey after the SIP with the percent of "greater than" responses increasing as the offered risk decreases. For the other two questions it is apparent that the "greater than" responses are higher for the .000001 risk offering than the other three, but the expected monotonic pattern is not clear.

To assess the baseline perceived risk of respondents, we first estimate the dichotomous choice risk model from the first survey only. Because some respondents have two responses for each risk question and others only have one, a random effects probit model with unbalanced panels is used. Table 6-3 reports the results of the baseline risk perception model. Sample weights based on county population are used to correct for the heavier sampling of North Carolina, and rural areas. The only controls in the baseline model are dummy variables for the state of residence.

The random effect parameter measures the degree of correlation between the first and second responses. Its significance indicates positive but non-unitary correlation between the initial risk offering and the follow-up. The insignificance of the state dummy variables indicates that there is little systematic variation in responses across states. Also reported in Table 6-3 is the sample average perceived risk. For a given individual, the median perceived risk is:

$$(6.17) \quad r = \frac{1}{1+e^{sb}} .$$

Averaging the predicted median risk perception across the sample results in a predicted perceived risk of .000048, or a 4.8 out of 100,000 chance of getting sick from the seafood meals eaten during a month.

Table 6-4a and 6-4b presents the estimation results for the quantitative risk models. Explanatory variables included in the various models include demographic variables: years in state (STATE), number in household (HOUSE), number of children in household (CHILDREN), years of education (EDUC), age (AGE), a dummy for male respondents (MALE), and urban county dummy (URBAN), and INCOME (in $10,000's). This model also includes the dummy variables to indicate the various information treatments: hypothetical major (MAJOR) and minor (MINOR) fish kills, Pfiesteria brochure (PFIEBROC), counter information (COUNTER), and seafood inspection program (SIP).

Five versions of the full model are estimated, with each model containing various sets of covariates. Tables 6-4a and 6-4b report the estimation results for the five models. Model 1 represents a limited information estimation. The model contains four state specific dummy variables, and fixed effects dummy variables for the various information treatments. If no other information is available to the decision maker, Model 1 assesses the impact of the various information treatments on the perceived risk of illness from seafood. Parameters estimated are $b^* = \left\{ \frac{1}{s}, -\frac{b}{s} \right\}$. The actual parameters on covariates have the opposite sign of those reported here, but because the parameters appear in the denominator of the risk function, the marginal effect has the opposite sign of the true parameter.

The results are somewhat surprising. The first striking result is the significant increase in perceived risk due to the Pfiesteria brochure. The additional information provided to respondents in the form of definitions and explanations of Pfiesteria appears to have scared the respondents into thinking seafood is more risky than they originally thought. The second striking result is the inefficacy of the counter information. The counter information states explicitly that seafood is safe to eat, and it is safe to swim and boat in coastal waters. Respondent risk perceptions do not react in the expected way. The size of the fish kill has a significant effect on risk perceptions with the major fish kill leading to a larger increase in perceived risk than the minor fish kill. The effect of the minor fish kill is indistinguishable from zero.

The seafood inspection program has a large and significant effect on perceived risk of illness from seafood. The seafood inspection program counteracts the increases in perceived risk from the brochure and the fish kill, and reduces risk beyond the baseline risk case (before the fish kill and information treatments).

Models 2 through 5 incorporate various other controls to attempt to explain how risk perceptions are affected by the information treatments. Model 2 incorporates socio-demographic variables similar to those included in the qualitative risk model in the previous section. The results are for the most part as expected with years in state significantly decreasing perceived risk and the number of people in the household increasing the perceived risk. Somewhat surprisingly, the number of children significantly decreases the perceived risk (and this result is robust across models). It is tempting to argue that households with children might consume less seafood, but even when the number of meals consumed is included (not shown), the children effect remains. The information effects for Model 2 are similar in magnitude, sign and significance to Model 1, with the brochure and major fish kill scenarios increasing the perceived risk of illness from seafood and the seafood inspection program counteracting this effect.

Model 3 is similar to Model 2 with the expectation that it controls for potential bias introduced by the survey itself. The major and minor fish kill scenarios are crossed with a dummy variable indicating whether the respondents thought the scenarios were very or somewhat realistic. These dummy interactions indicate that those that find the hypothetical scenarios realistic drive the significant fish kill effects. Interestingly the size effect disappears when the believability of the scenarios are accounted for. This may be partially explained by noting that a higher percentage of those offered the major fish kill found it realistic (44%) than those offered the minor fish kill (38%). Once those that think the scenario is unrealistic are accounted for, the size effect diminishes. Model 3 also includes a dummy variable to indicate whether the response is a second response (FOLLOW-UP). The significant negative parameter estimate on the follow-up variable indicates that respondents tend to say the risk is less than the offered amount on the follow-up given that they have already said less than 1%.

Model 4 further incorporates seafood perception variables elicited from the first survey. Not surprisingly, the perceptions of seafood have a significant effect on the perceived risk of seafood. The perceived risk of seafood increases if the respondent thinks that seafood is the most likely food to make them sick, or if they are very or somewhat concerned about seafood handling practices. The perceived risk of seafood decreases if the respondent thinks seafood is safe or somewhat safe. These variables do little to explain the efficacy of the information treatments or how perceptions are altered by those treatments, but they do serve as an internal validity test for the dichotomous choice with follow-up risk elicitation method. In other words, those with concerns about seafood and seafood safety are responding in the expected way. Inclusion of these variables does not affect the general conclusion regarding the information treatments.

Model 5 includes perception and knowledge variables for Pfiesteria. Counter to expectations, those that had heard of Pfiesteria (71%) in the first telephone survey (prior to receiving any information) have lower risk perceptions for seafood than those that had not heard of Pfiesteria (29%). The informational brochure increased perceived risk more for those that had heard of Pfiesteria than those that had not, indicating that individuals adjust their perceptions downward when informed of the facts about Pfiesteria. If the respondent reported being very or somewhat concerned about Pfiesteria on the first survey then their perceived risk of illness was higher. The information treatment effects remain robust to the inclusion of the Pfiesteria perception variables.

## Chapter 7. Seafood Demand Model

This chapter presents an econometric analysis of the five contingent behavior questions asked in the survey. The analysis is based on the demand theory presented in Chapter 2. We begin with a description of the five questions. Then, we present an empirical model based on the demand theory using a demand-difference approach in estimation. After laying out the model we present coefficient and welfare estimates along with an analysis of our findings.

### Five Contingent Behavior Questions

Contingent behavior questions ask respondents to consider hypothetical circumstances and to report how they might respond to these circumstances. Our survey has five contingent behavior questions. All pertain to how the respondent would change consumption of seafood in response to hypothetical circumstances.

The first two questions pose changes in the price of seafood. After responding to a number of questions about the amount and type of seafood eaten, each respondent is ask how their number of seafood meals consumed (monthly) would change if the price of seafood were to rise. And then, how it would change if prices were to fall. Questions 1 and 2 in Table 7-1 present the exact wording of the questions. These questions are posed in the initial phone survey and are designed to infer *the slope the seafood demand function*.

The next three questions pose hypothetical fish kills. In the first, Question 3 in Table 7-1, respondents are asked to consider a fish kill near where they live and how it would alter the number of seafood meals they consume. Respondents are provided details on the fish kill in a hypothetical press release and some information about fish kills in general in the mail survey described in Chapter 3. This question is designed to infer *shifts in the seafood demand function due to fish kills.*

The second fish kill question, Question 4 in Table 7-1, poses exactly the same circumstance as the previous question except that the respondents are asked to assume that there is a mandatory seafood inspection program in place at the time of the kill. This question is designed to investigate *the extent to which the shift in demand due the fish kill is attenuated by inspection programs.*

The final question, Question 5 in Table 7-1, is a slight variation on the previous question. The inspection program is still assumed to be in place but the respondent is told that the program cost money and will increase the price of seafood. This question is designed *to test whether or not the shift in demand with the inspection program is affected by the added cost of seafood.*

The size of the fish kill and amount of risk information provided to individuals varies across the sample. Respondents are given either a major or a minor fish kill in Questions 3 through 5. A major fish kill involves hundreds of thousands of fish over a large area of a river. A minor fish kill is involves less fish and over a smaller area. The size of the kill varies across respondents, but is constant across Questions 3 through 5 for each respondent. Respondents also receive different amounts of risk information. Each person receives either: (1) no risk information, (2) a brochure describing risks associated with Pfiesteria, or (3) the same brochure plus an information insert. The brochure, more or less, emphasizes that the risks of eating seafood are not changed as a result of the fish kills. The insert is much the same but is more direct and emphasizes that seafood is safe. These different treatments allow us examine *the extent to which the demand shifts vary with the size of fish kill and with the amount of information provided about health risks.*

Now lets turn to the demand framework we use to analyze these questions.

<u>Demand Model</u>

*Basic Linear Model*

Following the theory presented in Chapter 2, we assume demand functions for individuals of the following form

(7.1) $$x = f(p, y, r(s), d; b).$$

$x$ is the monthly quantity of seafood meals, p is the price of a seafood meal, y is income, $r$ is perceived health risk from eating seafood meals, $s$ is a vector of variables believed to influence perceptions about risks, and $d$ is a vector of individual characteristics. $b$ is a parameter vector to be estimated.

This follows the framework initially developed by Shulstad and Stoevener (1978) who were the first to incorporate an information variable within the demand function. Their study measured the welfare losses to pheasant hunters who discontinued hunting due to news concerning mercury-contaminated pheasants. They called these losses 'avoidance costs', as essentially, it's the welfare loss to the hunter in avoiding the contaminated product.

A linear form of the model for analyzing the contingent behavior questions is

(7.2) $$x = b_p p + b_y y + b_s s + b_d d + e.$$

With $s$ entering equation (7.2) directly, we have a reduced form of equation (7.1). In our model $s$ is a vector of the following elements

(7.3) $$s = maj, min, brc, ins, sip, ipr.$$

*maj* is a dummy variable for major fish kill, *min* is a dummy for minor fish kill, *brc* is a dummy for having received a Pfiesteria brochure, *ins* is a dummy for having received the additional insert on health risks, *sip* is a dummy for state inspection program, and *ipr* is the increase in the price of seafood due to the inspection. Again, see Chapter 3 for details and survey questions for each variable.

From equation (7.3) the coefficients on *maj* and *min* are expected to be negative – shifting demand to the left as shown in Figure 1. Major kills should shift demand more than minor kills. The underlying hypothesis with *maj* and *min* is that individuals have misperceptions about the dangers of seafood consumption believing it is dangerous to eat after a Pfiesteria fish kill when if fact the dangers are slight.

The coefficients on *brc*, *ins*, and *sip* are expected to be positive – information on risks shifts demand "back" to the right as shown in Figure 2. The null hypothesis with *brc* and *ins* is that the safety information will work to counter the misperception of seafood health risks and reduce the extent of the leftward shift. The latter, may be thought of as recovering unnecessary welfare losses. Introduction of a seafood inspection program should also work to shift demand "back" to the right.

Finally, the coefficient on *ipr* is expected to be negative – shifting demand to the left. If the seafood inspection program increases the price of fish we expect individuals to consume less.

The use of positive information variables in the demand function began with Swartz and Strand (1981). They used Shulstad and Stoevener's (1978) framework to consider whether the avoidance costs incurred by consumers reacting to negative media coverage could be offset with the provision of positive information, assuring consumers about a product's safety. Swartz and Strand (1981) hypothesized that in many cases consumers were acting with imperfect information. That is, after negative media coverage about a contaminated product consumers are often unsure of the safety of consuming the remaining supplies, and so, reduce their consumption, even if these remaining supplies are safe. They tested this by analyzing the effects on demand for oysters in the Baltimore area, after the news of prohibiting the harvesting of oysters from the James River in Virginia. They chose Baltimore since oysters sold there are not harvested from the James River. They found that consumers in Baltimore did reduce their demand for oysters, and that with better information welfare losses were avoidable.

Following this, other studies have also analyzed the welfare effects from negative product coverage, and the effect that positive safety assurances can have on reducing these losses. Smith et al. (1988) measured the impact of media coverage on milk bans in Hawaii on the demand for milk. Brown and Schrader (1990) considered the effects of media coverage about cholesterol on the demand for eggs. Wessels et al. (1994) analyze the welfare effects from news of domoic acid contamination of mussels from Prince Edward Island, on the demand for mussels. In all studies, they find that negative media coverage has a significant effect on reducing demand for that specific product. However, they also find that the coefficients on the positive information variables are insignificant, suggesting positive product information has little effect on consumer behavior. These findings go against the Swartz and Strand (1981) result and throw in to doubt our null hypotheses on *brc*, *ins*, and *sip*.

It is important to keep in mind that our model aggregates across species of fish. So, the quantities demanded are sums (eg., summing the number of meals of tuna, crab, catfish and so on). The price term is an aggregate index across these species.

In our analysis we use demand-differencing to estimate the parameters in equation (7.2) and to test our hypotheses. We describe this method in the next two sections.

*Demand Difference to Estimate Slope*

Now, consider the contingent behavior questions for a change in the price of seafood. Individuals are asked to report their quantity demanded $x_0$ at the current price $p_0$. Then, they are asked how much their quantity demanded would change with a hypothetical change in price. Let $\Delta x$ be the reported change in the quantity demanded and $\Delta p$ the size of the hypothetical price change.

In terms of our demand model, we have

$$(7.4) \qquad x_0 = b_p p_0 + b_y y_0 + b_s s_0 + b_d d_0 + e_0$$

as the quantity demand at the current price $p_0$. And,

$$(7.5) \qquad x_1 = b_p (p_0 + \Delta p) + b_y y_1 + b_s s_1 + b_d d_1 + e_1$$

as the quantity demanded at the new hypothetical price $p_0 + \Delta p$. Subtracting equation (7.4) from equation (7.5) gives our demand-difference

$$(7.6) \qquad \Delta x = b_p \Delta p + (e_1 - e_0)$$

where $\Delta x = x_1 - x_0$ is the change in the quantity consumed in response to the hypothetical price increase. The term $b_y (y_1 - y_0) + b_s (s_1 - s_0) + b_d (d_1 - d_0)$ drops out of the demand difference because $y_1 = y_0$, $s_1 = s_0$, and $d_1 = d_0$. There is no variation in income, risk factors, or individual characteristics between the current state and the hypothetical state in the survey. The term $(e_1 - e_0)$ is the difference in error terms, which we assume is non-zero.

We estimate $b_p$ using equation equation (7.6). Variation in price comes from the survey design – individuals receive different $\Delta p$ 's in the contingent behavior questions. For a price increase $\Delta p$ takes on a value of either \$1, \$3, \$5, or \$7 (Question 1 in Table 7-1). For a price decrease it takes on a value of \$-1, \$-2, \$-3, or \$-4 (Question 2 in Table 7-1). Individuals of course report $\Delta x$ in response to the price change.

We estimate separate equations for price up and price down in our analysis. These are

$$(7.7)\qquad \begin{aligned} \Delta x_{Q1} &= b_{pu}\Delta p_{up} + e_{Q1} \qquad n_{Q1} = 1680 \\ \Delta x_{Q2} &= b_{pd}\Delta p_{down} + e_{Q2} \qquad n_{Q2} = 1700 \end{aligned}$$

where $n_{Qi}$ is the number of observations responding to question $i$ and $e_{Qi}$ is an error term difference. Recall that everyone in the sample is asked both questions, so the equations in (7.7) are over the same people. Sample sizes vary slightly due to measurement error in the survey instrument.

*Demand Difference to Estimate Shifts*

The method for estimating shifts in demand is essentially the same. Individuals are asked to report their current quantity of seafood consumption $x_0$. Then, they are asked how their quantity demanded would change with a fish kill in their area.

Once again, in terms of our demand model, we have

$$(7.8)\qquad x_0 = b_p p_0 + b_y y_0 + b_d d_0 + e_0$$

as the current demand. The vector *s* is excluded since we assume that $maj_0 = min_0 = brc_0 = ins_0 = sip_0 = ipc_0 = 0$ in the current state. The quantity demanded with the hypothetical fish kill then is

$$(7.9)\qquad \begin{aligned} x_1 = {} & b_p p_1 + b_y y_1 + b_d d_1 + b_{maj} maj_1 + b_{\min} min_1 \\ & + b_{brc} brc_1 + b_{ins} ins_1 + b_{sip} sip_1 + b_{ipc} ipc_1 + e_1 \end{aligned}$$

Subtracting equation (7.8) from equation (7.9) gives

$$(7.10)\qquad \Delta x = b_{maj} maj_1 + b_{\min} min_1 + b_{brc} brc_1 + b_{ins} ins_1 + b_{sip} sip_1 + b_{ipc} ipc_1 + (e_1 - e_0)$$

where $\Delta x = x_1 - x_0$ is the change in the quantity consumed in response to the hypothetical fish kill. In this case $b_p(p_1 - p_0) + b_y(y_1 - y_0) + b_d(d_1 - d_0)$ drops out of the demand difference because $p_1 = p_0$, $y_1 = y_0$, and $d_1 = d_0$ . There is no change in $p$, $y$, and $d$ between the current and hypothetical states in the contingent behavior question. The elements in *s*, however, do change and this gives rise to specification in eq. 7.10.

Consider Question 3. Individuals face either a major or a minor fish kill. If their fish kill scenario is major, then $maj_1 = 1$ and $min_1 = 0$. If their scenario is minor, then

$maj_1 = 0$ and $min_1 = 1$. Individuals are also given one three levels of information: (1) no information, (2) a brochure, or (3) a brochure and an insert. If they receive no information, $brc_1 = 0$ and $ins_1 = 0$. If they receive a brochure, $brc_1 = 1$ and $ins_1 = 0$. If they receive both, $brc_1 = 1$ and $ins_1 = 1$. And finally, by design $sip_1 = ipc_1 = 0$ in Question 3. So, our demand-difference is

$$(7.11) \qquad \Delta x_{Q3} = b_{maj} maj_1 + b_{min} min_1 + b_{brc} brc_1 + b_{ins} ins_1 + e_{Q3} \qquad n_{Q3} = 795.$$

Again, $n_{Q3}$ is the number of observations responding to the question is smaller than $n_{Q1}$ and $n_{Q2}$ because it only includes respondents recruited to answer the follow-up mail survey.

In Question 4, everyone is asked how their response to Question 3 would differ if a seafood inspection program had been in place. In this case, $sip_1 = 1$ for everyone in the sample. The other right hand side variables are the same as before. Question 5 is the same as 4 except that individuals are told that the inspection program will increase the price of fish by $ipc_1$. The price increase may be \$1, \$3, \$5, or \$7.

The equations for Questions 4 and 5 then are

(7.12)

$$\Delta x_{Q4} = b_{maj} maj_1 + b_{min} min_1 + b_{ins} brc_1 + b_{cnt} ins_1 + b_{sip} sip_1 + e_{Q4} \qquad n_{Q4} = 813$$
$$\Delta x_{Q5} = b_{maj} maj_1 + b_{min} min_1 + b_{brc} brc_1 + b_{ins} ins_1 + b_{sip} sip_1 + b_{ipc} ipc_1 + e_{Q5} \qquad n_{Q5} = 811$$

The term $b_{maj} maj_1 + b_{min} min_1 + b_{brc} brc_1 + b_{ins} ins_1$ appears in both equations because all the circumstances applying in Question 3 carry forward to Questions 4 and 5. Each respondent's fish kill scenario and risk information is the same.

*Gathering Equations for Estimation & Some Notes on the Econometrics*

In estimation we stack equations (7.7), (7.11), and (7.12) giving a basic linear model with 8 parameters to be estimated

$$
\begin{aligned}
&\Delta x_{Q1} = b_{pu} \Delta p_{up} + e_{Q1} \\
&\Delta x_{Q2} = b_{pd} \Delta p_{down} + e_{Q2} \\
(7.13) \qquad &\Delta x_{Q3} = b_{maj} maj_1 + b_{min} min_1 + b_{brc} brc_1 + b_{ins} ins_1 + e_{Q3} \\
&\Delta x_{Q4} = b_{maj} maj_1 + b_{min} min_1 + b_{brc} brc_1 + b_{ins} ins_1 + b_{sip} sip_1 + e_{Q4} \\
&\Delta x_{Q5} = b_{maj} maj_1 + b_{min} min_1 + b_{brc} brc_1 + b_{ins} ins_1 + b_{sip} sip_1 + b_{ipc} ipc_1 + e_{Q5}.
\end{aligned}
$$

Stacking allows us to constrain parameters across equations to be constant and to estimate the model with random effects. Random Effects allows the error terms in the model to be correlated across equations for each observation. For example, it stands to reason that the same unobserved elements that influence and individual's shift in demand due to a fish kill without and inspection program will also influence that individual's shift with an inspection program in place. Since all observations in the sample do not make it to second survey and since there is some attrition due to simple cleaning of the data, an unbalanced version of a random effects model is estimated.

The model is also estimated as a Tobit regression with censoring at $-x$, the negative of the quantity consumed. This is because individuals cannot reduce their consumption of fish by more than the current quantity consumed. Since individuals consume different quantities, the censoring point varies across observations. See Greene (1997, p. 962) for more on the basic Tobit Model. We use LIMDEP 7.0 to estimate the model.

*Nonlinear and Interactive Versions of the Model*

We also consider a nonlinear version of the model and versions with interactive independent variables. In the nonlinear model, the demand difference takes the same form as (7.13) except that the dependent variable is now $\frac{\Delta x}{x}$. This allows the slope and extent of the shift to vary with the level of the quantity consumed. Censoring in this model occurs at –1 for all observations and random effects still apply. For the baseline quantity demanded, $x$ in the denominator of the new dependant variable, we use what an individual states that he or she is likely to consume next month. Since the contingent behavior question is presented in terms of quantity consumed next month, this is a logical choice over last month's or a typical month's consumption.

If $p$ or elements in $s$ interact with individual characteristics then shifters will enter the demand-difference equations. For example, if the effects of price changes and fish kills vary with income, then (7.2) takes the form

$$x = b_p p + b_s s + b_d d + b_y y + b_{py}(p \cdot y) + b_{sy}(s \cdot y) + e, \tag{7.14}$$

and the demand-differences for slope and shift changes become

$$\begin{aligned} \Delta x &= b_p \Delta p + b_{py}(\Delta p \cdot y) + (e_1 - e_0) \\ \Delta x &= b_p \Delta s + b_{sy}(\Delta s \cdot y) + (e_1 - e_0) \end{aligned}. \tag{7.15}$$

In our application we consider models with and without interactions. The interactive model includes three shifters: income (*inc*), a dummy variable for residing in North Carolina (*NC*), and a dummy variable for having consumed a species of fish likely to be viewed as unrelated to the threat of the fish kill (*fish*). The species included in *fish* are King mackerel, Mahi-mahi, Orange Roughy, Pollock, Salmon, Shark, Swordfish, Tuna, Whitefish, Whiting, Lobster, Shrimp, and Scallops.

The income shifter will pick up differences across income groups. Higher income groups, for example, may be less responsive to price changes than lower income groups.

The North Carolina dummy is intended to pick potential differences across the split sample, split north and south. The southern sample is over residents of North Carolina. The northern sample is over residents of Maryland, Virginia, and Delaware (see Chapter 3). Each sample considers a fish kill in its own region. The coefficient on the North Carolina dummy will pick up differences between these samples.

Finally, individuals report the types of finfish and shellfish eaten in the past month. Some of these species are likely to be viewed as unrelated to the fish kill. The hypothetical fish kills take place on rivers in brackish waters. It seems reasonable that individuals may consider the risks associated with eating deep sea fish (eg., tuna or shrimp) and perhaps some freshwater fish as entirely unrelated to the hypothetical kills. The non-threatened fish dummy is intended to capture this effect – a smaller demand shift. It is clearly an imperfect measure. For example, an individual may presently eat no fish in the non-threatened group but consider switching to these species in the event of a fish kill. If the switch is easy, the same effect will be present for these people.

*Consumer Surplus*

In the linear model an individual's consumer surplus for seafood meals is

$$(7.16) \qquad cs_{linear} = \frac{x^2}{-2b_p}.$$

We estimate $cs_{linear}$ for each observation using the reported level of monthly consumption ($x$) and the estimated value of $b_p$ in our model. This measure corresponds to area A in Figure 3. The same consumer surplus in the nonlinear version of the model is

$$(7.17) \qquad cs_{log\text{-}lin} = \frac{x}{-b_p}.$$

Again we calculate $cs_{log\text{-}lin}$ for each person in the sample using reported levels of $x$ and an estimate of $b_p$. For surplus measures in *per meal* terms one simply divides $cs_{linear}$ or $cs_{log\text{-}lin}$ by $x$, the number of meals consumed per month.

The change in consumer surplus for a hypothetical fish kill is

$$(7.18) \quad \Delta cs_{linear} = \left\{ \frac{(x+\Delta x)^2}{-2b_p} - \frac{x^2}{-2b_p} \right\}$$

$$(7.19) \quad \Delta cs_{log\text{-}lin} = \left\{ \frac{x+\Delta x}{-b_p} - \frac{x}{-b_p} \right\} = \frac{\Delta x}{-b_p}$$

This is simply difference in the consumer surplus with and without the kill and corresponds to the area B in Figure 4. This is sometimes called avoidance cost – an individual's cost of avoiding fish after a kill.

The same calculation can be made assuming the individual has been provided with risk information. In this case, the change in surplus, the avoidance cost, is the area C in Figure 5. The area D may be thought of as the avoidance cost saved as a result of information provision. Again, the measures may be converted to *per meal* terms by dividing by $x$.

Response Data

Before turning to the estimation of the model, it is useful to take a look at the response data for the 5 contingent behavior questions. Figures 6 and 7 show the distribution of responses for Questions 1 and 2. Recall that dollar increases and decreases vary across the sample. Figures 6 and 7 aggregates people across these dollar amounts.

More than half the respondents make no change in their monthly consumption in response to the price changes – 55% report no change for an increase and 57% report no change for a decrease. For a price increase, about 30% say they would decrease the number of meals consumed by 1 or 2 meals per month. For a price decrease, 30% say they would increase consumption by 1, 2, or 3 meals. The average number of meals consumed in a month in the sample is about 5.

Table 7-2 shows the distributions by dollar amount. The distributions give the impression of a downward sloping demand function. For price increases the change in quantity consumed is nearly always negative and gets larger in absolute value for greater increases; the reverse holds for price decreases. A few respondents report an increase in consumption with a price increase, and a decrease in consumption with a price decrease – about 2 to 5% of the sample.

The large number of zeros for the change in the quantity consumed is consistent with theory. The number of seafood meals consumed is discrete giving a step demand function like Figure 8, which implies threshold prices at each quantity. For example, if the price were to rise from $p_0$ to $p_1$ we would observe no change in the quantity consumed. A price rise to $p_2$, on the other hand, surpasses the threshold and we would observe a change in the quantity consumed. It appears as though a large fraction of the price changes posed to individuals in our sample are like the $p_0$ to $p_1$ change; they do not surpass the threshold and hence we observe a zero change in consumption.

In our model we estimate an approximation to this discrete demand function. In the linear model we estimate the line in Figure 9, approximating a step function in which step height is assumed to be constant. By excluding areas like A and including areas like B, the surplus measures using the linear approximation are reasonable. The nonlinear model makes a similar approximation to a step function with non-constant step heights.

The data may seem natural for a count data model -- the quantity changes are discrete and a large fraction of the responses occur at zero. However, we have opted not to use a discrete model in our analysis. The primary reason is that there is no demand model corresponding to a Poisson Model with $\Delta x$ as the discrete dependent variable and $\Delta p$ as an explanatory variable. This is easy to see by noting that the slope of the demand function in such a Poisson Model would vary with the size of the change in $\Delta p$ and not with the absolute size of $x$ or $p$. There is also the problem of observing negative as well as positive values for our dependent variable. While it is possible to redefine dependent variables to circumvent this problem, the model would have to be compromised somewhat. We hope to explore use of count data models in some further research. Perhaps with alternative specifications or simply treating the results as local approximations, we may be able improve our modeling strategy.

Figures 7.10, 7.11, and 7.12 show the distribution of responses for the fish kill questions. Recall that the size of the fish kill and level of information received varies over the sample. The numbers presented in these figures are aggregated over all treatments. Again, the percent of respondents reporting no change in consumption is over 50% for all three questions.

For the case of a fish kill without an inspection program (Question 3 and Figure 10), 65% report they would make no change in consumption, 22% would reduce consumption by 1 or 2 meals, 8% by 3 to 5 meals, and 3% by more than 5 meals. Approximately 2% report that they would increase consumption with a fish kill. Again, the average number of meals consumed is about 5 in the sample. The yellow (or lightly shaded) area in Figure 10 indicates the portion of the sample that stops eating fish entirely for that level of quantity change. Of those who reduce consumption, approximately 40% stop eating fish for that month.

For the case of the fish kill with an inspection program (Question 4 and Figure 11), there is a significantly different profile suggesting consumer confidence in the programs. With the program about 80% of the sample report that they would make no change in consumption, 7% would still reduce consumption by 1 or 2 meals, and 4% by 3 or more. Approximately 9% say they would actually increase consumption with a fish kill if it resulted in the implementation of an inspection program.

However, when individuals are told that the price of fish will go up by $1, 3, 5, or 7 to pay for the program (Question 5 and Figure 12), the profile looks more like the case of a fish kill without an inspection program. Now, only 58% reduce consumption to zero, 26% cut back by 1 or 2 meals, 9% by 3 to 5 meals, and 4% by more than 5 meals. Still, 3% report that they would increase consumption following the kill.

Now we will turn the regression results for the models presented in the previous section.

## Results

The regression results appear in Tables 7.3 and 7.4. These are Random Effect Tobit regressions with censoring at the negative of the number of meals consumed. We present “Short” and “Long” versions of the model. The Short Model corresponds to equations (7.13). The Long Model is the same but includes interactive terms for income, North Carolina, and non-threatened fish species. Consumer surplus measures per month are presented in Tables 7.5 and 7.6.

The surplus measures in the tables include the total surplus *per seafood meal* and the change in surplus due a fish kill *per seafood meal* under different scenarios. In these scenarios we report avoidance costs separately for major and minor kills assuming individuals have (1) no information, (2) a brochure, (3) a brochure and an insert, (4) an inspection program in place, and (5) an inspection program with a price rise. We present consumer surplus measures only for the Short Models to save space. The Long Models give somewhat lower estimates but the qualitative story is the same. We will also discuss our results primarily in terms of the Short Models and then briefly explained what is learned in the Long versions of the models.

There are several noteworthy findings. First, the effects of a price increase and a price decrease are asymmetric – the slope of the demand function is larger for a decrease than for an increase. In the Short Linear Model the coefficient on *pdwn* is -.346, and the coefficient on *pup* is -.218. This basic result persists across the models. Figure 13 shows the effect graphically – a “kink” in the demand function is shown at point of current consumption. Quantity demanded seems to be more responsive to a price decreases than price increases. This finding appears to be consistent with the well-know result from Prospect Theory that value of things lost is greater than the value of things gained. This analysis holds up if one accepts that price increases are like “losses” and price decreases are like “gains”. One may be inclined to argue that this is due to individuals’ inability to reduce consumption beyond their current level thereby capping the response to price increases. However, keep in mind that we have estimated a Tobit version of the model which accounts for truncation at current consumption.

The asymmetry complicates the calculation of consumer surplus because the coefficient on price appears in the denominator of all of measures of surplus (see equations (7.16)-(7.19). For this reason, in Tables 7.5 and 7.6, we present our consumer surplus measures in pairs – one using the coefficient for a price increase and the other for a price decrease. For example, at the top of the Table 7-5, the total consumer surplus *per meal* in the Short Linear Model is $11.24 (price up) or $7.06 (price down). There is perhaps some justification for using the price up results since all the measures of surplus we consider are integrated over the portion of the demand curve corresponding to a price increase (see Figs. 7.3 and 7.4).

Second, the coefficients on *maj* and *min* are negative and significant as expected. Fish kills appear to shift the seafood demand function to the left as shown in Figure 1. Certainly, this result is supported by the other studies mentioned earlier. It is commonly believed that negative media coverage does have a significant effect on reducing demand. Anderson (1991) remarks that in the seafood industry, after negative media coverage, seafood consumers tend to leave the market altogether, as they are unable to distinguish between safe and unsafe seafood. One possible explanation for this is the lack of brand names in the seafood market. This implies less commitment to the product, so negative media coverage on seafood may have a significant effect as consumers do not have a quality brand name to commit to. Ahluwalia et al. (2000) suggest that consumers committed to a brand instinctively counteract negative information about that brand, and so, mitigate the effects of the negative information. Therefore, in the seafood market, the lack of brand names may cause seafood consumers to reduce their seafood consumption altogether, after news of a fish kill.

What is unexpected in our result, is that the effect of a major kill and a minor kill are about the same. There is no statistical difference in the coefficients on *maj* and *min* in the Short Models. There is some separation in the Long Models, but even here accounting for the interactive terms, the difference is not large. The implication is that the size and scope of a fish kill is not particularly important. What seems to matter is whether or there has been a fish kill at all. If so, some apparent threshold is crossed signaling a risk associated with eating fish and hence a shift in demand.

The avoidance cost associated with the fish kills are reported in Tables 7.5 and 7.6. Ignoring for the moment the cases with information provision and inspection programs, the avoidance cost per meal with a minor or major fish kill is on the order of \$2.70 to \$4.30 *per meal* in the linear model and \$0.75 to \$1.75 *per meal* in the non-linear model.

Third, information provision in the form of a brochure or a brochure along with stronger counter information appears to have limited sway on consumers. The coefficients on *brc* and *ins* are consistently statistically insignificant. We get little of that expected rightward shift “back” shown in Figure 2. The avoidance cost associated with the fish kills assuming individuals have a brochure or have a brochure and counter information then is about the same as the cost with no information. Again, see Tables 7.5 and 6. This finding seems to suggest that simply providing information based on experts’ judgments carries little weight in altering individuals’ perceptions. Of course, it is also possible that the manner in which the information was packaged and presented was the cause for the limited impact.

Our result is consistent with Smith et al. (1988), Brown and Schrader (1990), and Wessels et al. (1994). The coefficients on *brc* and *ins* suggest that positive information has less of an effect on consumer behavior than any negative media coverage. In fact, Kroloff (1988) found that the impact of media exposure gives negative news quadruple weight compared with positive news. Sherrell et al. (1985) thought this was an underestimate and calculated that it takes five times more positive information to offset the effects of any negative information.

In reasoning why positive product information has little effect on demand relative to negative media coverage, the literature on information conveyance gives some useful insight. There is a commonly shared belief among communication practitioners that a communicator's character has a significant effect on the persuasiveness of their appeals. Hovland and Warren (1969), Crano (1970) Ross (1973), Johnson et al. (1968), Sternthal et al. (1978) and others have all analyzed this concept. Source credibility and whether the information is deemed to be in the source's best interests are important factors in determining whether a communicator's message is accepted or rejected. The coefficients on *brc* and *ins* suggest that respondents are not accepting the source of the information being conveyed as credible, and perhaps the respondents believe the information conveyed is in the source's best interests. These factors could be possible explanations as to the insignificance of the positive information on consumer behavior.

Fourth, the presence of an inspection program, unlike information provision, shifts the demand function significantly rightward – returning close to its pre-fish kill position. The coefficient on *sip* in both Short Models nearly perfectly offsets the initial shift due to the hypothetical fish kill. The coefficients are also statistically significant. This result is consistent with Wessels and Anderson (1995) who considered the role of a variety of measures in providing seafood safety assurances. They found that consumers placed a high value on a seafood inspection program. Our results imply that the cost of the kill, with the inspection program in place, drops dramatically. As shown in Table 7-5 the cost of the fish kill using the linear model is now only \$.10 to \$.05. And, using the nonlinear model there is really no loss. These results hold up in the Long Models as well. It seems that people place confidence in the inspection programs and that the uncertainty created by a Pfiesteria outbreak is alleviated by such a program.

Fifth, the impact of a rise in seafood prices due to an inspection program is about the same as a general price rise – a sensible result. The coefficient on *pup* is -.218 and -.061 in the linear and nonlinear models, while coefficients on *ipc* are -.183 and -.060. Of course, this has the potential of offsetting some of the recaptured losses by the inspection program. In Tables 7.5 and 7.6 we present the welfare loss of a fish kill assuming an inspection program is in place and raises the price of fish \$1. The gains due to the inspection program are largely lost.

Sixth, as we already mentioned, incorporating additional covariates into the demand difference model has little effect on our qualitative or quantitative results. We introduce three interactive variables, income, a dummy for residence in North Carolina, and a dummy for consumption of non-threatened fish. Our intention is see whether or not the relevant slopes and shifts in seafood demand vary with these covariates. Others could have been introduced as well such as age and education. To keep it simple, we narrowed it to these three.

The three covariates add 48 new parameters to the model. Of these, only three were statistically significant. All are on the price/income interaction.

We included the income variable (*inc*) reasoning that the effects of price changes may be different across different income groups and that the response to fish kills and information provision may differ across classes. Our results show some evidence of varying responses to price but not to information provision. Higher income groups appear to be less responsive to price increases and more responsive to price decreases then lower income groups.

The dummy for residence in North Carolina (*nc*) was included to pick up any difference that may occur between northern and southern respondents. Given differences in the populations and location of the fish kill, it seems likely that there may be a difference in the demand slopes and shifts. This does not appear to be the case. None of the North Carolina covariates in the linear model are significant. The signs imply that North Carolina residents are generally less responsive to counter information than northern residents and more responsive to price declines. Otherwise, the slopes and demand shifts appear to be about the same across the two areas.

Finally, we include a dummy for consumption of a species of fish thought to be unrelated to our kill scenarios. Our reasoning here is that individuals who consume such fish may be less inclined to alter their consumption of fish in response to the kill since their preferred species are less likely to be involved in the kill and perceived as being associated with the attendant risks. There is some weak evidence of this effect. The coefficients on *fish* when interacted with *maj* are positive with some statistical significance. Again, the *fish* variable has drawbacks – first, anyone can switch to a non-threatened species and second, which species people actually perceived as threatened may diverge from our list.

## Conclusion

As expected, individuals react to fish kills by reducing consumption of fish even though the nature of the fish kill is not likely to pose increased health risks. This result has been documented elsewhere in the literature and suggests that there may be a role for government in providing information to consumers about risks.

When individuals reduce seafood consumption they are said to incur "avoidance costs". If the real risk of eating seafood is low, these avoidance cost are in a sense incurred mistakenly by individuals. The benefit of a government information program then is the avoidance cost saved by informing consumers. The avoidance in question here appears to be rather large. Using our model, the aggregate cost over the four state region is on the order of \$50 to \$130 million per month depending on the amount of risk information provided to individuals and which measure for the price coefficient we use (price up or price down).

We found that consumers were not responsive to "expert" risk information sent in a mail packet in the form of a brochure. The brochure emphasized that eating fish after a kill was safe. For the most part, individuals behaved as they would have without the information. Hence, the savings in avoidance cost was small. Perhaps experts have little sway in how individuals form perceptions of risk. Or, perhaps our information packets and method of dissemination failed to communicate the risk meaningfully.

On the other hand, we found that consumers were quite responsive to seafood inspection programs. Avoidance costs are nearly eliminated by the hypothetical program used in our experiment. This suggests that consumers have confidence in such programs and that concrete action by government authorities is can affect consumer decisions. But, we also found the much of gain in surplus realized by such programs can easily dissipate if individuals believe if will lead to a rise, even a small rise, in the price of fish.

There were a number of other interesting findings. Individuals did not seem to differentiate between major and minor sized fish kills. We surmised that there is some threshold level that triggers a response by consumers and that our kills surpassed that threshold. We also found the people responded asymmetrically to price increases and price decreases – people were more responsive to price decreases.

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**Figure 1: Shift in Demand Due to a Fish Kill**

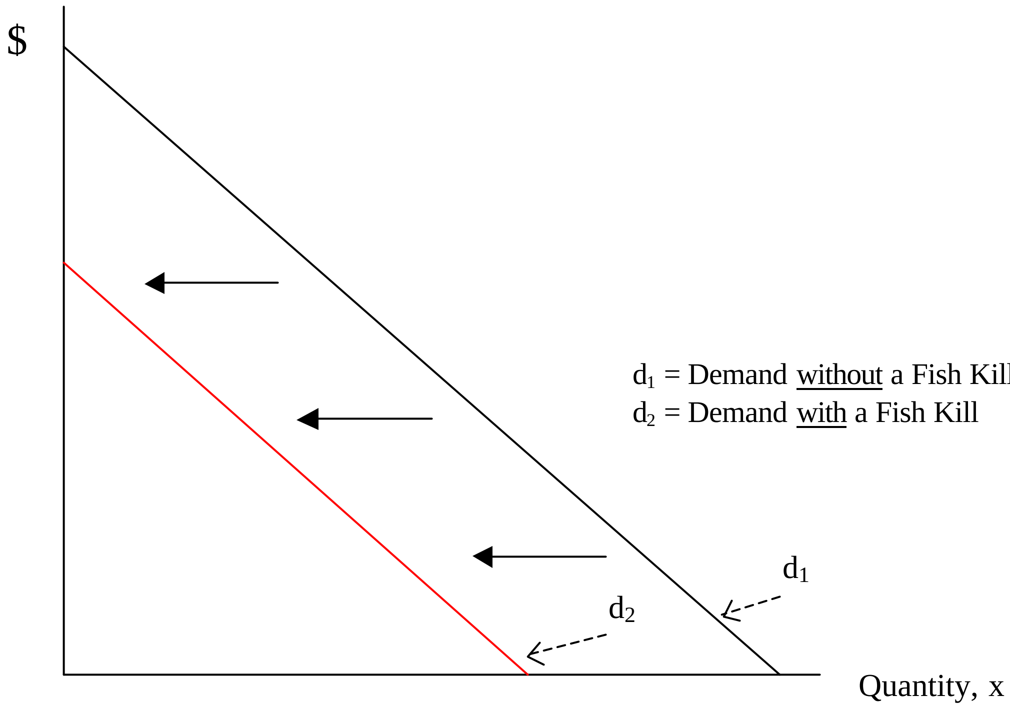


**Figure 2: Shift "Back" With Risk Information**

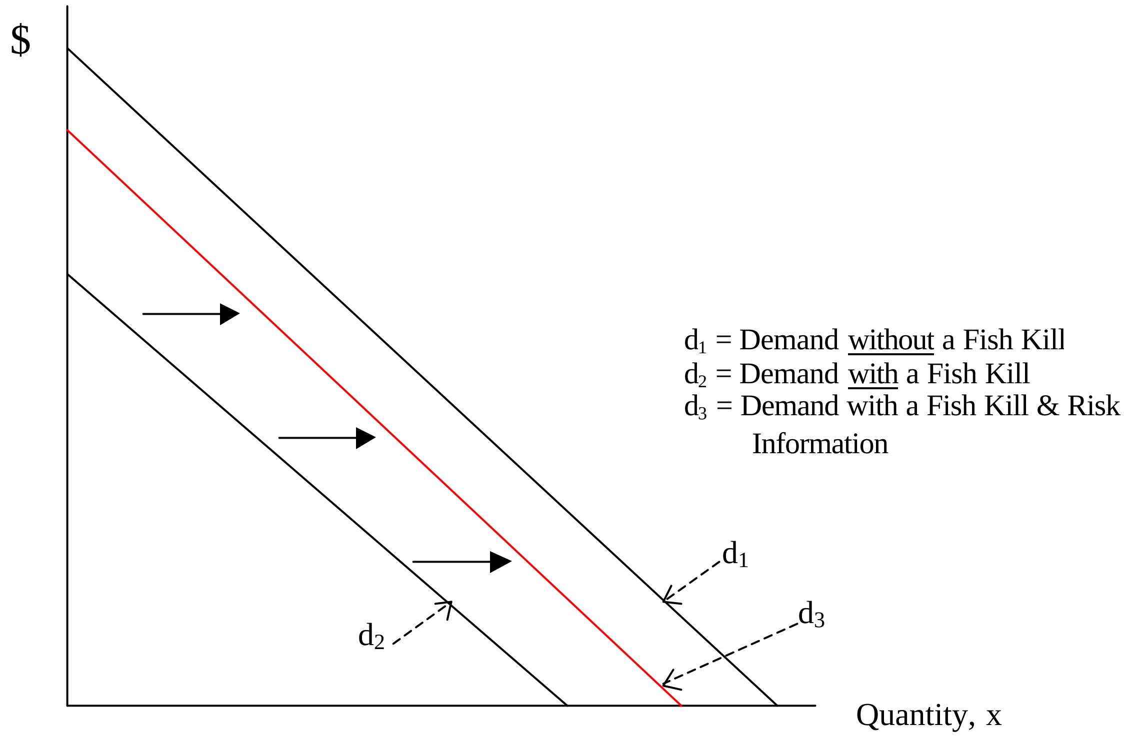


**Figure 3: Total Consumer Surplus for Monthly Seafood Consumption**

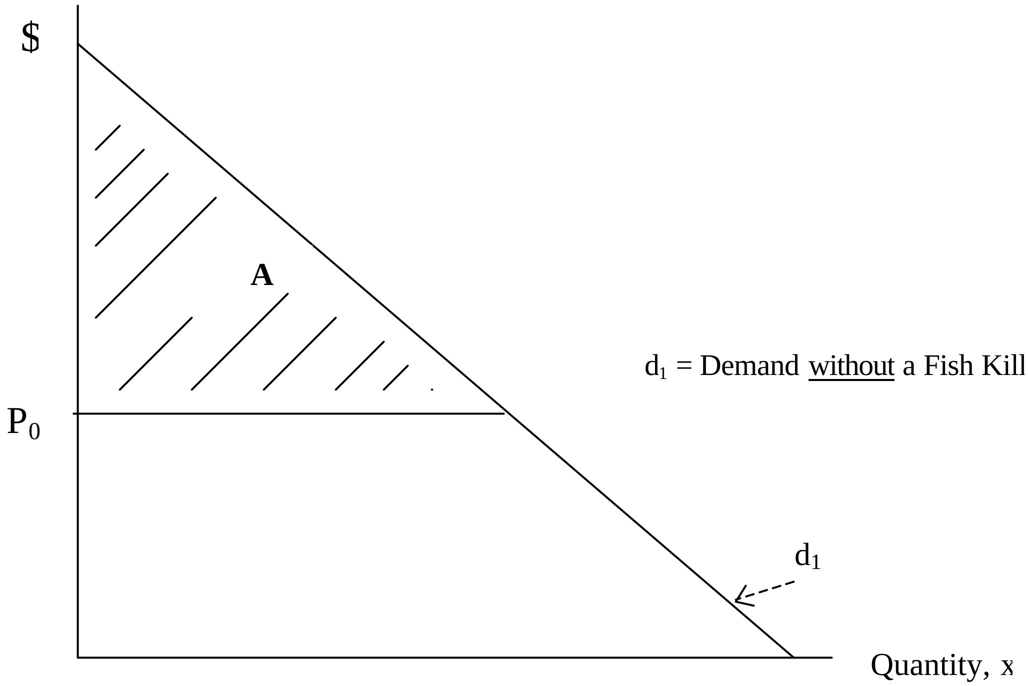


**Figure 4: Change in Consumer Surplus Due to a Fish Kill**

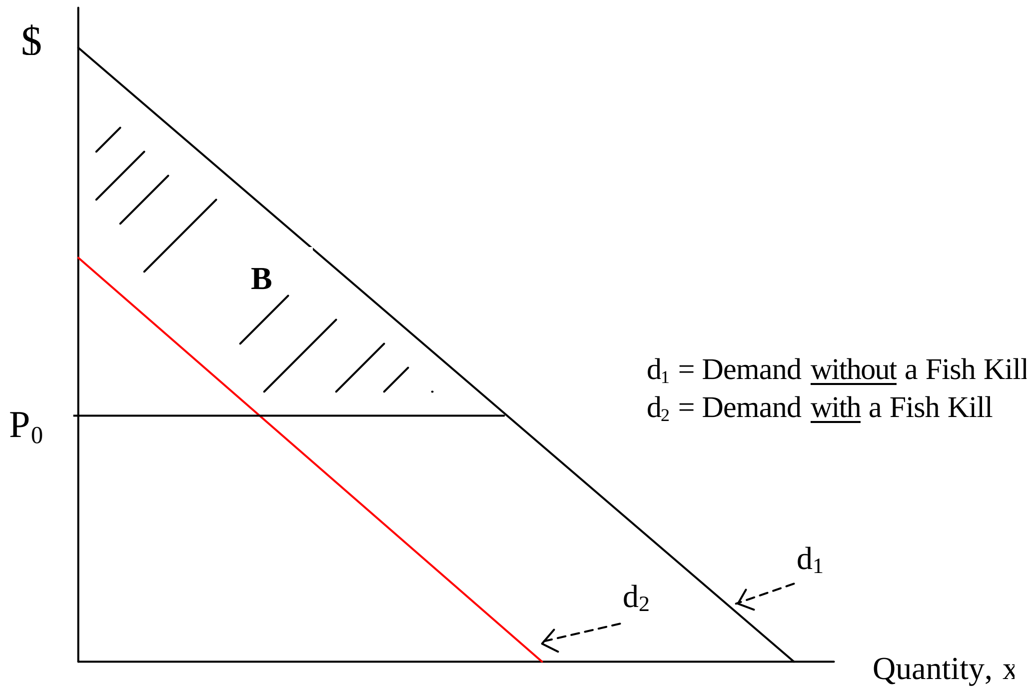


**Figure 5: Change in Consumer Surplus Due to a Fish Kill and With Risk Information**

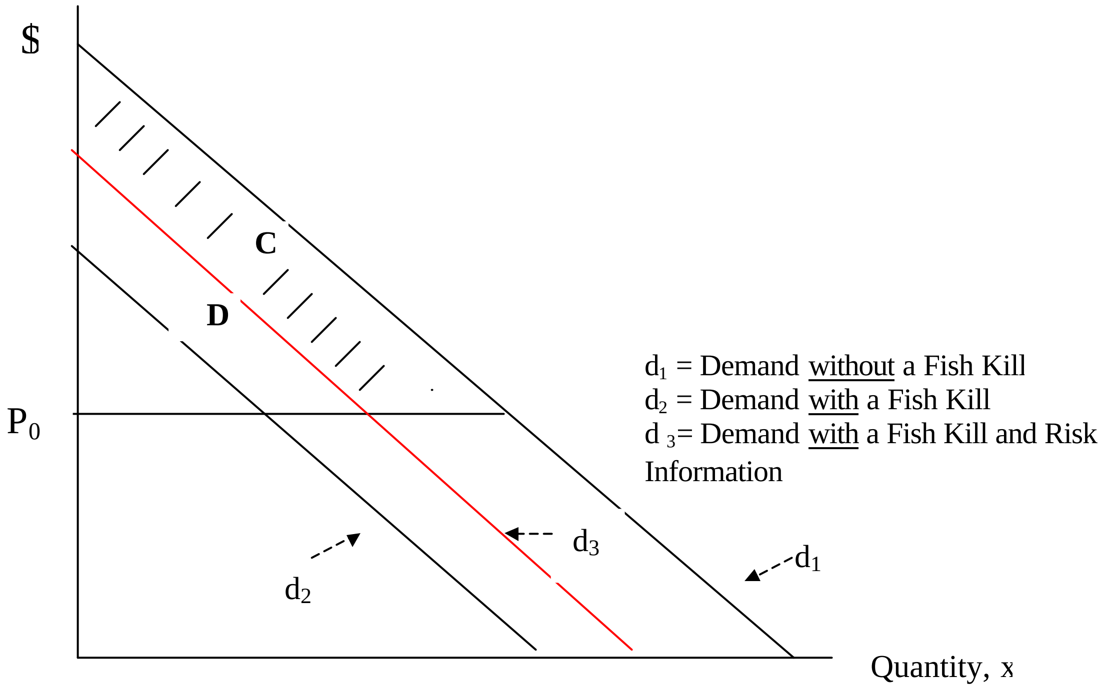


**Figure 6: Change in Seafood Meals Consumed with a Price Increase**

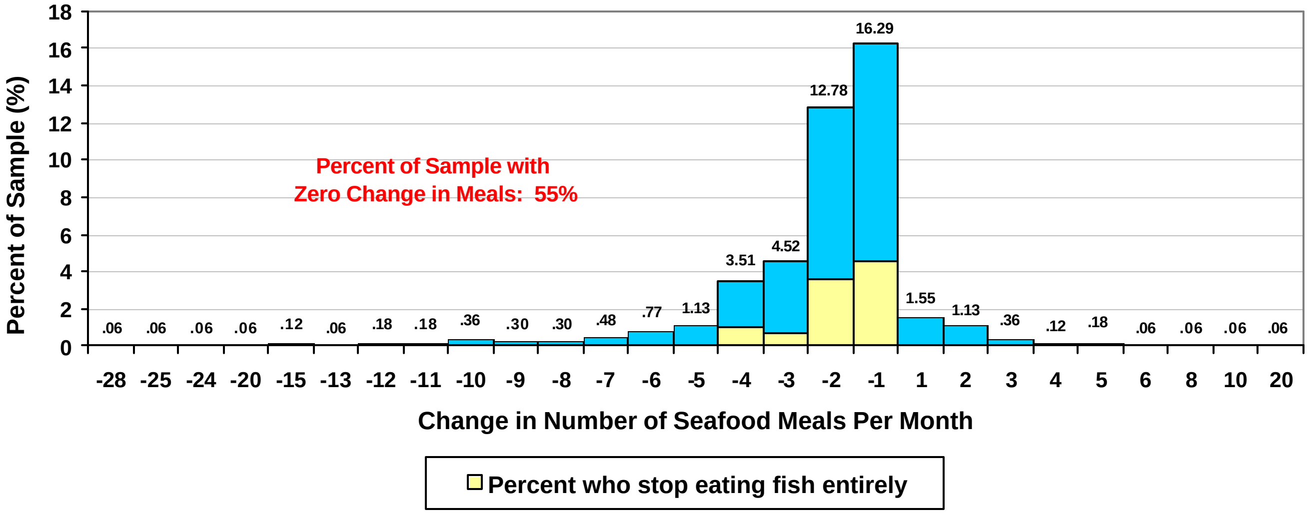


**Figure 7: Change in Seafood Meals with a Price Decrease**

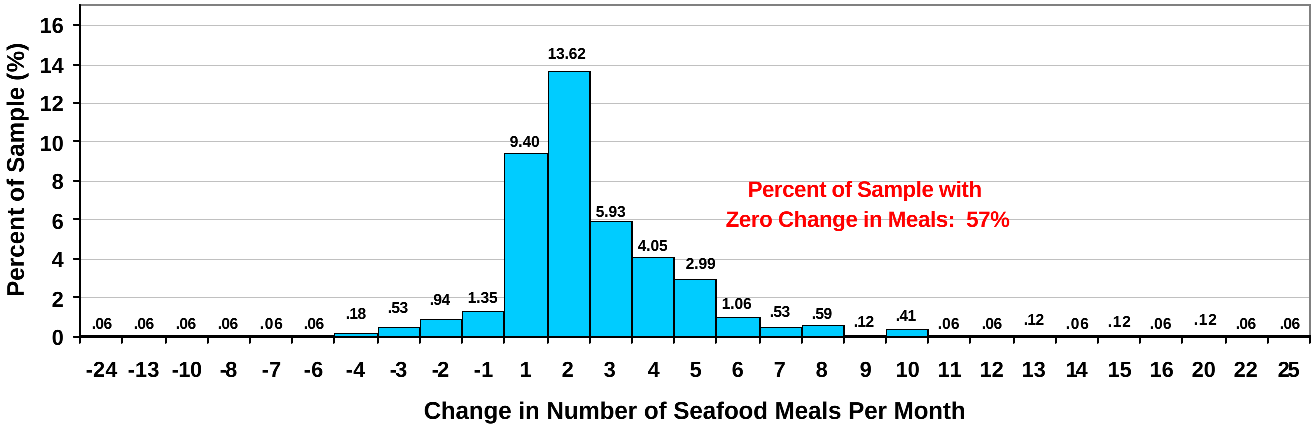


**Figure 8: Seafood Demand Function with Discrete Units**

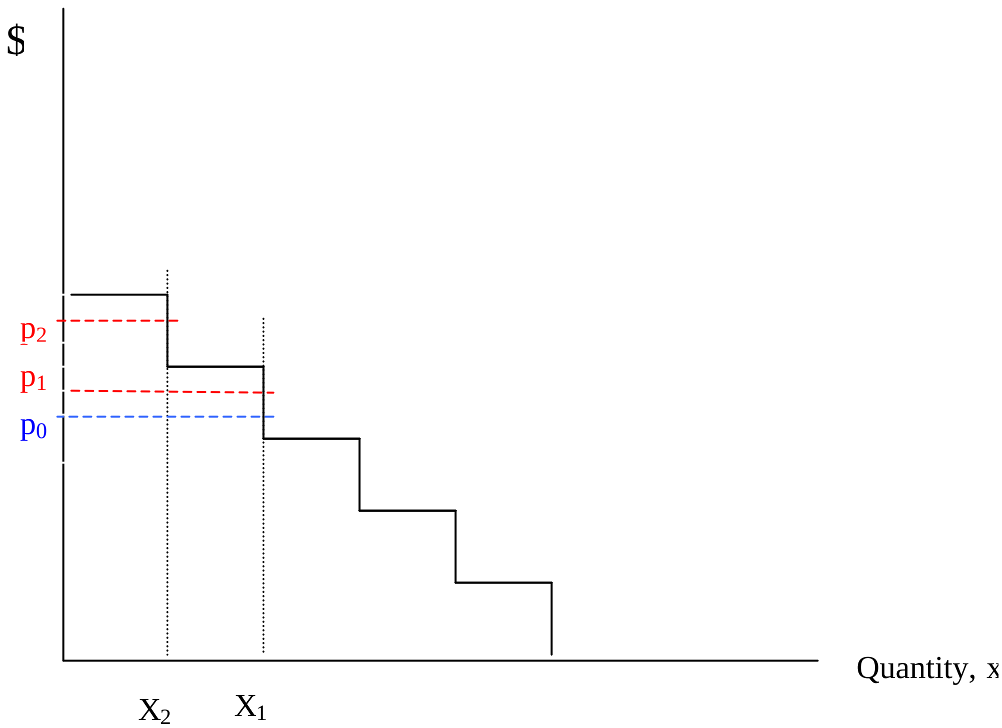


**Figure 9: Linear Approximation to Discrete Response Data**

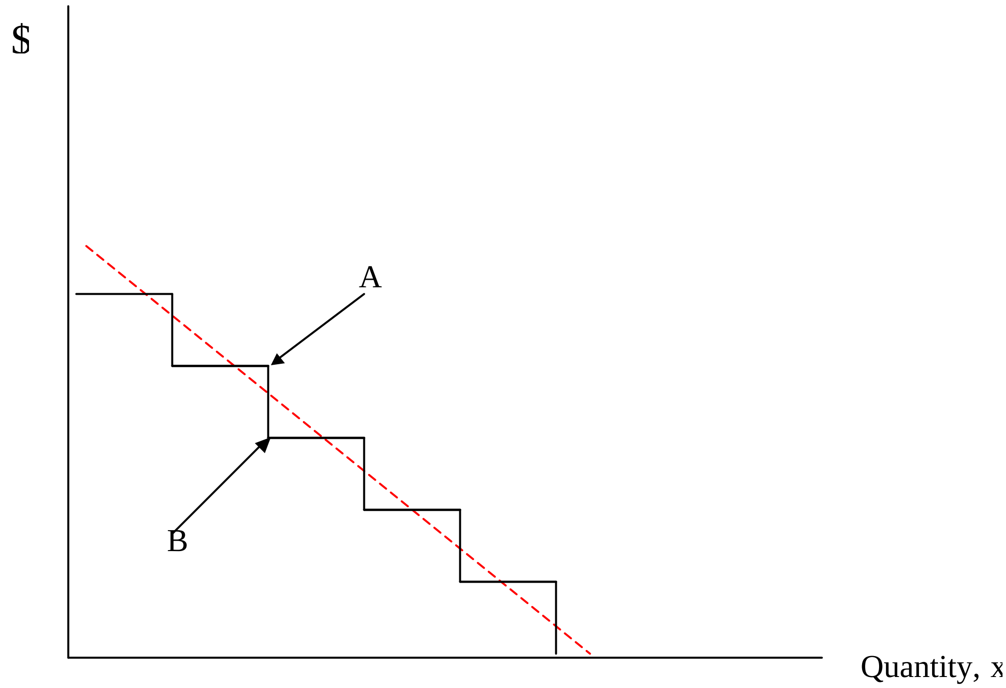


**Figure 10: Change in Seafood Meals Consumed with a Fishkill**

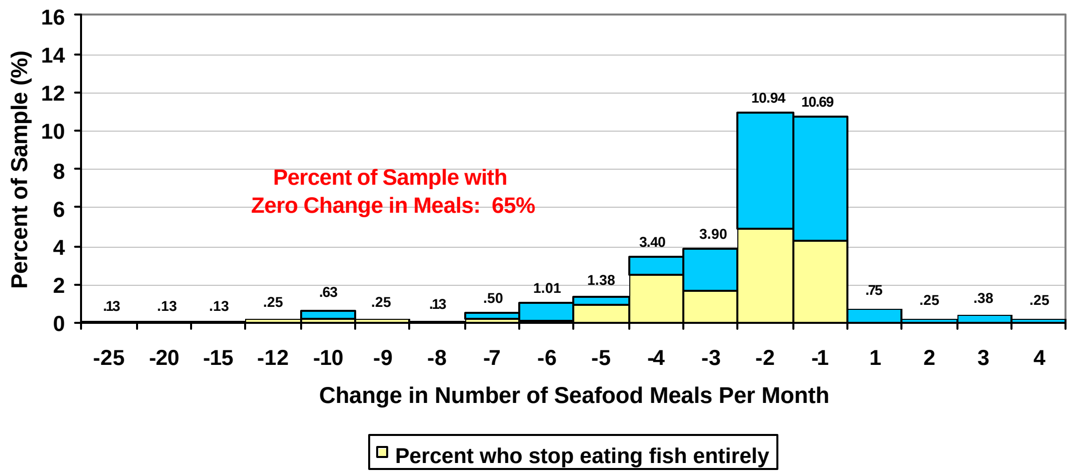


**Figure 11: Change in Seafood Meals Consumed with a Fishkill and an Inspection Program**

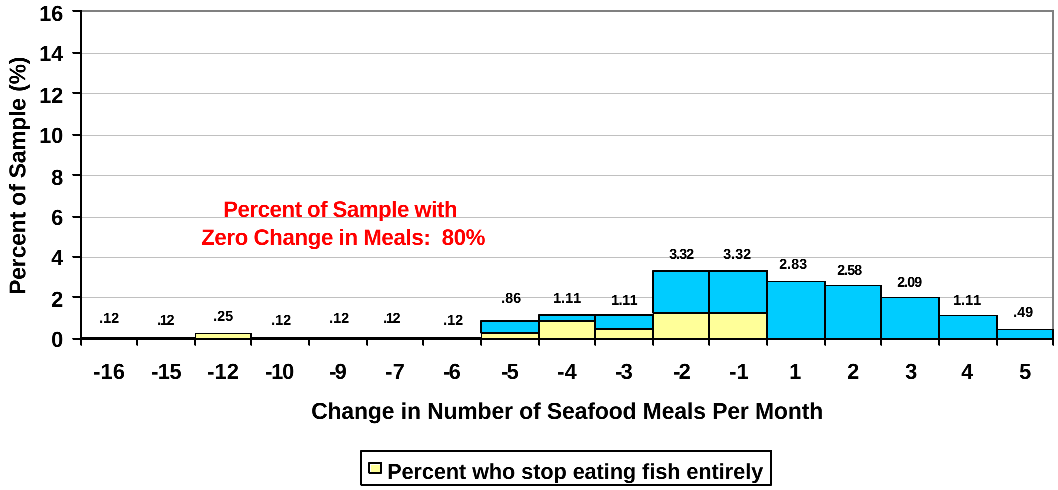


**Figure 12: Change in Seafood Meals Consumed with a Fishkill and Paying for an Inspection Program**

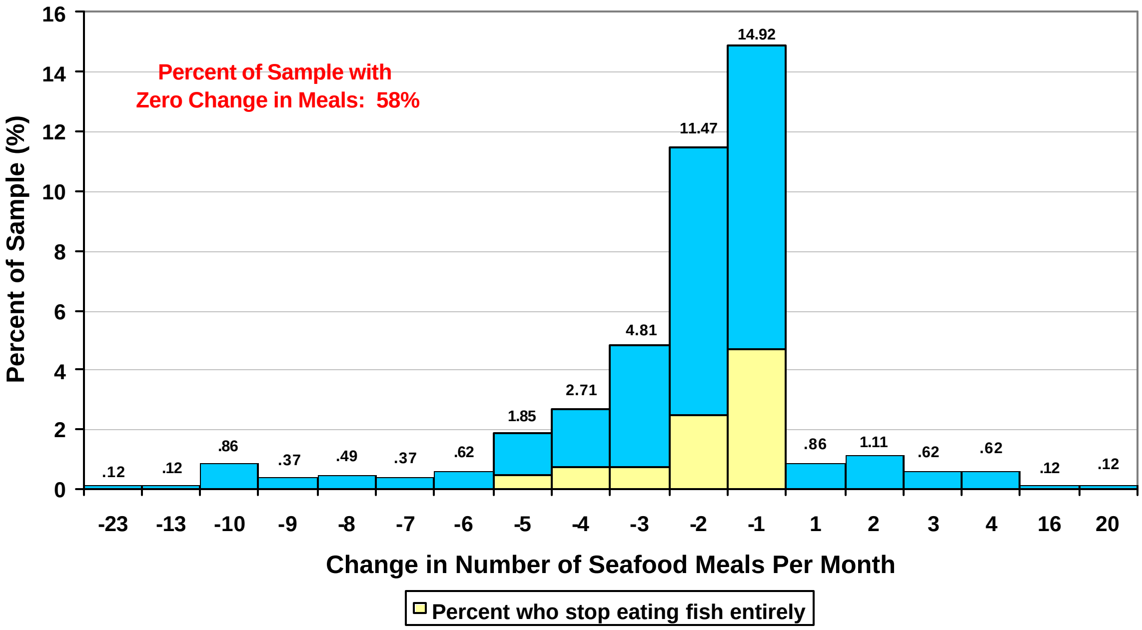
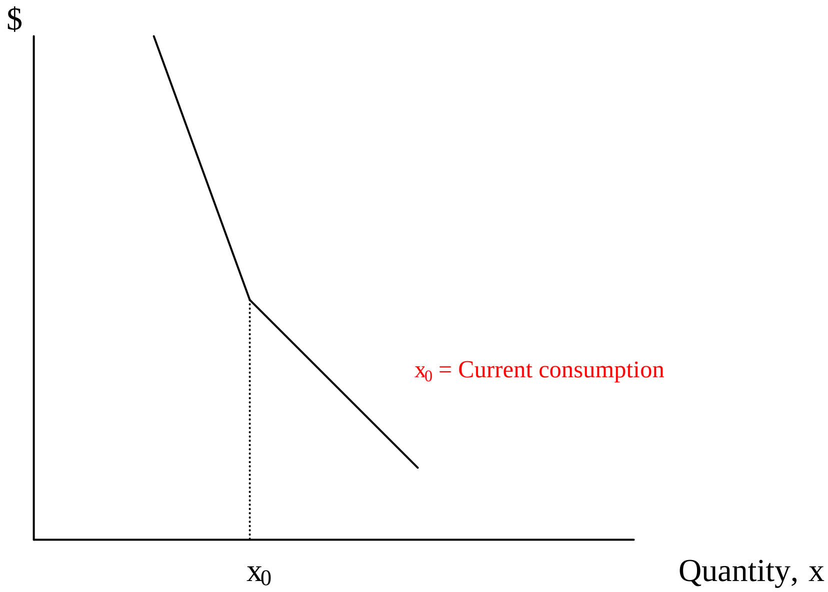


**Figure 13: Kink in Seafood Demand Function at Current Level of Consumption**



# Chapter 8. Willingness to Pay for a Seafood Inspection Program

In this chapter we estimate the willingness to pay for a seafood inspection program. We begin with a brief description of the theoretical contingent valuation model. Then we describe empirical implementation of the theoretical model. After description of the data we present the empirical results. Finally we present a valuation function and willingness to pay estimates.

## Theoretical Model

The contingent valuation method is a direct approach to estimating the welfare effects of a change in health risk resulting from a seafood inspection program. This can be accomplished directly by asking a willingness to pay question. For example, a seafood consumer could be presented with the following stylized question: "would you be willing to pay $\Delta p$ in higher seafood prices in order to gain a mandatory seafood inspection program?" An alternative form of the question, and the one adopted in this study, is in terms of a referendum vote: "would you vote for or against a mandatory seafood inspection program if it cost $\Delta p$ in higher seafood prices?"

Assuming that a seafood inspection program reduces the perceived risk of seafood consumption the willingness to pay question creates the following problem for the seafood consumer

$$
(8.1) \qquad \begin{aligned} &\tilde{e}\left(p, r^{o}, \tilde{u}\right) - \tilde{e}\left(p, r'' \tilde{u},\right) \frac{\geq}{<} \Delta p \\ &\Delta\tilde{e} \frac{\geq}{<} \Delta p \end{aligned}
$$

where $r^o$ is the baseline risk and $r''$ is the reduced risk resulting from the seafood inspection program. If $\Delta p$ is greater than $\Delta\tilde{e}$, the consumer will be "against" the referendum. If $\Delta p$ is less than $\Delta e$, the consumer will be "for" the referendum.

## Comparative Statics

In order to derive the comparative static relationships between the exogenous variables and willingness to pay, substitute the indirect utility function into equation (2.20)

$$
(8.2) \qquad \begin{aligned} WTP &= \tilde{e}\left(p, r^{o}, \tilde{v}(p, r^{o}, y)\right) - \tilde{e}\left(p, r'', \tilde{v}(p, r^{o}, y)\right) \\ &= y - \tilde{e}\left(p, r'', \tilde{v}(p, r^{o}, y)\right) \end{aligned}
$$

where the baseline utility level is associated with the baseline risk, $r^o$.

*Price Effect: No Seafood Quality Difference*

Assuming that price differences are the result of cross-sectional variation in the market price and not a result of quality differences, $\frac{\partial p}{\partial q} = 0$, the comparative static effect of price on willingness to pay is

$$\text{(8.3)} \qquad \frac{\partial WTP}{\partial p} = -\left( \frac{\partial \tilde{e}''}{\partial p} + \frac{\partial \tilde{e}''}{\partial \tilde{v}} \frac{\partial \tilde{v}^{o}}{\partial p} \right)$$

where $\tilde{e}''$ is the expenditure function evaluated at *r"* and $\tilde{v}^{o}$ is the indirect utility function evaluated at $r^{o}$. Since the marginal cost of utility is equal to the inverse of the marginal utility of income, $\frac{\partial \tilde{e}}{\partial \tilde{v}} = \frac{1}{\partial \tilde{v} / \partial y}$

$$\text{(8.4)} \qquad \frac{\partial WTP}{\partial p} = -\left( \frac{\partial \tilde{e}''}{\partial p} + \frac{\partial \tilde{v}^{o} / \partial p}{\partial \tilde{v}'' / \partial y} \right)$$

Multiplication of the second term in parenthesis by one $\left( \frac{\partial \tilde{v}^{o} / \partial y}{\partial \tilde{v}^{o} / \partial y} = 1 \right)$ and rearranging yields

$$\text{(8.5)} \qquad \begin{aligned} \frac{\partial WTP}{\partial p} &= -\left( \frac{\partial \tilde{e}''}{\partial p} + \frac{\partial \tilde{v}^{o} / \partial y}{\partial \tilde{v}'' / \partial y} \frac{\partial \tilde{v}^{o} / \partial p}{\partial \tilde{v}^{o} / \partial y} \right) \\ &= -\left( \frac{\partial \tilde{e}''}{\partial p} + q \, \frac{\partial \tilde{v}^{o} / \partial p}{\partial \tilde{v}^{o} / \partial y} \right) \end{aligned}$$

where $0 < q = \frac{\partial \tilde{v}^{o} / \partial y}{\partial \tilde{v}'' / \partial y} \gtrless 1$. If reduced risk and income are substitutes, $\frac{\partial \tilde{v}^{o}}{\partial y} > \frac{\partial \tilde{v}''}{\partial y}$, and $q$ > 1. If reduced risk and income are complements, $\frac{\partial \tilde{v}^{o}}{\partial y} < \frac{\partial \tilde{v}''}{\partial y}$, and $q < 1$. If risk and income are not related in consumption then $q = 1$. However, any deviation of $q$ from one should be small (i.e., $q \to 1$).

By Roy's theorem, and after substitution of the indirect utility function into the compensated demand function (see equations 2.10 and 2.12), the effect of price on willingness to pay depends on the difference in uncompensated demand functions

$$(8.6)\qquad \frac{\partial WTP}{\partial p} = -\left(x^c(p, r'', \tilde{u}) - qx(p, r^o, y)\right)$$
$$= -\left(x(p, r'', y) - qx(p, r^o, y)\right) < 0$$

As $q \to 1$ the value inside the parentheses is positive since the demand for seafood is greater with lower risk. The effect of price on willingness to pay is negative. On the other hand the value inside the parentheses will be negative and the effect of price on willingness to pay will be positive when $q > \frac{x''}{x^o} > 1$. This situation is possible for risk changes that have small effects on quantity.

*Price Effect: Seafood Quality Differences*

When the effect of seafood quality on price is positive the effect of price on willingness to pay is the cross-partial derivative

$$(8.7)\qquad \frac{\partial^2 WTP}{\partial p \partial q} = -\left(\frac{\partial x''}{\partial p}\frac{\partial p}{\partial q} - q\,\frac{\partial x^o}{\partial p}\frac{\partial p}{\partial q}\right)$$
$$= -\frac{\partial p}{\partial q}\left(\frac{\partial x''}{\partial p} - q\,\frac{\partial x^o}{\partial p}\right)$$

If the risk change leaves the slope of the demand function constant then $\frac{\partial x''}{\partial p} = \frac{\partial x^o}{\partial p}$ and the effect of quality on willingness to pay is

$$(8.8)\qquad \frac{\partial^2 WTP}{\partial p \partial q} = -\frac{\partial p}{\partial q}\frac{\partial x}{\partial p}(1-q) \gtreqless 0$$

Since $\frac{\partial p}{\partial q} > 0$ and $\frac{\partial x}{\partial p} < 0$ the product outside the parentheses is positive. If reduced risk and income are substitutes, $(1-q) < 0$, the effect of price on willingness to pay is negative. If risk and income are complements, $(1-q) > 0$, the effect of price on willingness to pay is positive. If risk and income are not related in consumption, $(1-q) = 0$, the effect of price on willingness to pay is zero.

If the risk decrease causes the demand curve to become more elastic (i.e., price has a larger effect on quantity with lower risk and the demand curve rotates counter-clockwise at the choke price) then $\left|\frac{\partial x''}{\partial p}\right| > \left|\frac{\partial x^o}{\partial p}\right|$ and the effect of quality on price will be positive

$$\text{(8.9)} \qquad \frac{\partial^2 WTP}{\partial p \partial q} = -\frac{\partial p}{\partial q}\left(\frac{\partial x''}{\partial p} - q\frac{\partial x^o}{\partial p}\right) > 0$$

when $\dfrac{\partial x''/\partial p}{\partial x^o/\partial p} > q$. This condition is likely as $q \to 1$.

*Income Effect*

The effect of income on willingness to pay is

$$\begin{aligned} \frac{\partial WTP}{\partial y} &= 1 - \frac{\partial \tilde{e}''}{\partial \tilde{v}^o}\frac{\partial \tilde{v}^o}{\partial y} \\ \text{(8.10)} \qquad &= 1 - \frac{\partial \tilde{v}^o/\partial y}{\partial \tilde{v}''/\partial y} \\ &= 1 - q \end{aligned}$$

If reduced risk and income are substitutes then the effect of income on willingness to pay is negative. If reduced risk and income are complements the effect of income on willingness to pay is positive. If reduced risk and income are not related in consumption then the income effect is zero.

*Risk Effects*

The effect of baseline risk on willingness to pay is positive

$$\text{(8.11)} \qquad \frac{\partial WTP}{\partial r^o} = -\frac{\partial \tilde{e}}{\partial \tilde{v}^o}\frac{\partial \tilde{v}^o}{\partial r^o} > 0$$

since the marginal cost of utility is positive and the marginal utility of risk is negative. This derivative can be rearranged and expressed as the uncompensated inverse demand for risk reduction (i.e., *w* = marginal willingness to pay) by Roy's Theorem

$$\begin{aligned} \text{(8.12)} \qquad \frac{\partial WTP}{\partial r^o} &= -\frac{\partial \tilde{v}^o/\partial r^o}{\partial \tilde{v}^o/\partial y} \\ &= w(p, r^o, y) > 0 \end{aligned}$$

where the baseline risk is the reference point.

The effect of reduced risk on willingness to pay is the negative of the compensated inverse demand for risk reductions and, therefore, is positive

$$(8.13)\quad \frac{\partial WTP}{\partial r''} = -\frac{\partial \tilde{e}}{\partial r''} = w^c(p, r'', \tilde{u}) > 0$$

An increase in risk reduction decreases the expenditures necessary to achieve the reference utility level. Therefore, the negative of the negative effect is positive. Note that substitution of the indirect utility function into (8.12) yields the uncompensated inverse demand

$$(8.14)\quad w^c(p, r'', \tilde{v}(p, r'', y)) = w(p, r'', y)$$

Considering the problem slightly differently, the discrete change in the marginal willingness to pay, $\Delta w$, of the risk change, $\Delta r = r'' - r^o < 0$, is the difference in equations (8.11) and (8.13)

$$(8.15)\quad \Delta w = \frac{\partial WTP}{\partial r^o} - \frac{\partial WTP}{\partial r''} = w(p, r^o, y) - w(p, r'', y) > 0$$

which amounts to taking the vertical difference in two points on the inverse demand curve with money on the vertical axis and risk reduction on the horizontal axis. The effect of the reduced risk level on the discrete change in the marginal willingness to pay is

$$(8.16)\quad \frac{\partial \Delta w}{\partial r''} = -\frac{\partial w}{\partial r''} > 0$$

As the risk reduction increases (i.e., moves away from the baseline risk and the origin) the discrete change in marginal willingness to pay increases as the marginal willingness to pay for the reduced risk decreases. As the reduced risk level decreases the discrete change in marginal willingness to pay decreases as the marginal willingness to pay for reduced risk increases.

The effect of the baseline risk level on the discrete willingness to pay is

$$(8.17)\quad \frac{\partial \Delta w}{\partial r^o} = \frac{\partial w}{\partial r^o} < 0$$

As the baseline risk increases (decreases), the magnitude of the risk reduction decreases (increases), the marginal willingness to pay for risk reduction decreases (increases) and the discrete change in marginal willingness to pay decreases (increases).

Empirical Implementation

The “for” and “against” votes in the referendum will depend on the relationship between willingness to pay and the price change

$$(8.18) \quad For = \begin{cases} 1 & if \quad WTP \geq \Delta p \\ 0 & if \quad WTP < \Delta p \end{cases}$$

where *For* = 1 if the respondent votes “for” the referendum and *For* = 0 if the respondent votes “against” the referendum. In order to estimate the probability of a “for” vote empirically, consider the empirical expenditure function

$$(8.19) \quad \tilde{e} = \tilde{e}\left(p, r, v(p, r, y)\right) + h$$

where $h$ is a mean zero error term. Substitution of (8.18) into (8.1) yields

$$\begin{aligned} &\left[\tilde{e}\left(p, r^{o}, \tilde{v}(p, r^{o}, y)\right) + h^{o}\right] - \left[\tilde{e}\left(p, r'', \tilde{v}(p, r^{o}, y)\right) + h''\right] \frac{\geq}{<} \Delta p \\ (8.20) \quad & y - \tilde{e}\left(p, r'', \tilde{v}(p, r^{o}, y)\right) + h^{o} - h'' \frac{\geq}{<} \Delta p \\ & c(p, r^{o}, r'', y) + m \frac{\geq}{<} \Delta p \end{aligned}$$

where *c(.)* is the compensating surplus function and $m = h^{o} - h''$ is a mean zero error term.

The probability of a “for” response in the referendum is

$$\begin{aligned} (8.21) \quad p\,(For = 1) &= p\left[c(p, r^{o}, r'', y) - \Delta p \geq m\right] \\ &= p\left[\frac{c(p, r^{o}, r'', y) - \Delta p}{s} \geq \frac{m}{s}\right] \end{aligned}$$

where $s$ is the scale parameter. Assuming a linear functional form for the compensating surplus function yields

$$(8.22) \quad p\,(For = 1) = p\left[\frac{b_{o} + b_{1} p + b_{2} y + b_{3} r^{o} + b_{4} r'' - \Delta p}{s} \geq \frac{m}{s}\right].$$

Assuming a normal distribution for the error term the probit model results and the probit coefficient vector, $\left[\frac{b_0}{s}, \frac{b_1}{s}, \frac{b_2}{s}, \frac{b_3}{s}, \frac{b_4}{s}, \frac{-1}{s}\right]$, is estimated.

A seafood consumer who is indifferent between voting "for" or "against" the referendum will have a voting probability of *p(For)* = .50. Assuming a normal probability distribution, when the cumulative distribution function is evaluated at 0 the probability of a "for" vote will be .50

$$(8.23)\quad p\,(For=1)=\Phi\left[\frac{b_o+b_1p+b_2y+b_3r^o+b_4r''-\Delta p}{s}\right]$$

Therefore willingness to pay is equal to the price change that makes the seafood consumer indifferent in the referendum. The resulting willingness to pay function is

$$(8.24)\quad WTP=b_o+b_1p+b_2y+b_3r^o+b_4r''$$

where the censored probit coefficient vector ($b$) is estimated from the probit coefficient vector using the procedures described in Cameron and James (1987). Since the price change, *Dp*, is varied across respondents, $s$ can be identified and the willingness to pay function can be recovered.

Several predictions about the signs of the coefficients can be made based on the comparative static properties of willingness to pay. If quality is not reflected in the market price, the effect of price on willingness to pay is equal to the change in seafood meals as $q\to 1$, $b_1=\Delta x<0$, where $\Delta x$ is the difference between baseline seafood meals and meals with the risk reduction. If quality is reflected in market price then the effect of price on willingness to pay is positive, $b_1>0$, if (a) demand elasticity is constant with risk change and risk reduction and income are complements or (b) if demand elasticity increases with risk reduction and risk reduction and income are substitutes. With quality reflected in price the effect of price on willingness to pay is negative, $b_1<0$, if demand elasticity is constant with risk change and risk reduction and income are substitutes.

Other expected signs are more straightforward. The effect of income on willingness to pay is positive, $b_2>0$, if risk reduction and income are complements and negative, $b_2<0$, if risk reduction and income are substitutes. The effect of the baseline risk on willingness to pay is positive, $b_3>0$, and the effect of the reduced risk on willingness to pay is negative, $b_4<0$.

Alternatively, creating the risk change variable, $\Delta r=r''-r^o<0$, yields the following model

$$(8.25)\quad WTP=b_o+b_1p+b_2y+b_3\Delta r$$

where all coefficients have the same sign and interpretation except that $b_3=\Delta w>0$.

Data

The variables used in this analysis are described in Table 8-1. Respondents are asked whether they are for or against a seafood inspection program that would raise the average seafood price by *Dp* each meal, where ΔPRICE is our measure of *Dp*. Respondents are asked whether they believe that seafood prices would actually increase. This variable, HIGHER, is interacted with ΔPRICE to form two variables. The first measures the price variation for respondents who believe in the price change, BEL × ΔPRICE, where BEL = HIGHER. The second measures the price variation for respondents who do not believe in the price change, DBEL × ΔPRICE, where DBEL = 1 when HIGHER = 0 and zero otherwise.

Several variables are as described in previous chapters. PFIESBROC and COUNTER are dummy variables equal to one if the respondent received these information treatments and zero otherwise. PRICE is the weighted average home and restaurant seafood meal price. INCOME is household income in thousands. PRISKB is the predicted baseline risk (from Chapter 6) and our measure of $r^o$. PRISKSIP is the predicted risk with the seafood inspection program and our measure of *r"*. The change in risk variable, ΔRISK, our measure of Δr, is equal to PRISKSIP – PRISKB.

In addition to the independent variables suggested by economic theory, a number of variables are included in the models to determine their effects on willingness to pay. Theoretically, these variables parameterize the intercept term in the willingness to pay model. The names of most of these variables are the same as those presented earlier but many of them have been recoded into dummy variables.

Dummy variables for residents of Delaware, Maryland, and Virginia are included when appropriate. A vector of dummy variables is created to assess the effects of information use and assimilation on willingness to pay. UNDRPFST is equal to one if the respondent found the information treatments very helpful in understanding Pfiesteria and zero if information was somewhat helpful, not very helpful, or not helpful at all. EASY is equal to one if the respondent found the hypothetical questions to be very easy to answer and zero if they were somewhat easy, somewhat hard, or very hard to answer. CLOSELY is equal to one if the respondent read the information sent to them very closely and zero if they read the information somewhat closely, not very closely, or not closely at all. AMOUNT is equal to one if the respondent read all of the information sent to them and zero if they read just some of it. INFOWITH is equal to one if the respondent had the information with them when they answered the questions and zero otherwise. INSPECT is equal to one if the respondent found the information about the seafood inspection program to be very clear and zero if they found it to be somewhat clear, not very clear, or not clear at all.

A vector of six demographic variables is included in the empirical models to determine the effects of individual heterogeneity on willingness to pay. STATE is the number of years that the respondent had lived in their state of residence at the time of the survey. AGE is the age of the respondent. EDUC is the years of schooling that the respondent pursued. CHILDREN is the number of children in the household. WHITE is equal to one if the respondent is white and zero otherwise. MALE is equal to one if the respondent is male and zero otherwise.

A vector of dummy variables are created to measure the effects of attitudes and behavior related to Pfiesteria on willingness to pay. CONCERN is equal to one if the respondent is very concerned about Pfiesteria and zero if they are somewhat concerned or not concerned. AVOID is equal to one if the respondent had ever avoided eating seafood because of Pfiesteria and zero otherwise. REDUCE is equal to one if the respondent would reduce their seafood consumption with a Pfiesteria outbreak and zero otherwise. SWIM is equal to one if the respondent agreed or strongly agreed with the statement about swimming safety and zero if they disagreed or strongly disagreed. BREATHE is equal to one if the respondent agreed or strongly agreed with the statement about breathing safety and zero if they disagreed or strongly disagreed. EAT is equal to one if the respondent agreed or strongly agreed with the statement about seafood safety and zero if they disagreed or strongly disagreed.

A summary of these variables is presented in Table 8-2. We use complete case analysis dropping any unit with missing variables. The sample size is 745. The average price in this sample is $10 with a range of $1 to $26 and the average price change presented in the hypothetical referendum is $4 with a range of $1 to $7. Seventy percent of the respondents believed in the price change. This accounts for the larger mean for the interaction between BEL and the price change relative to DBEL and the price change. Seventy-two percent and 37% received the Pfiesteria brochure and the counter information. The average household income is almost $53,000. Twelve percent, 12%, and 10% of the sample are from Delaware, Maryland, and Virginia.

The mean predicted baseline risk of getting sick from eating seafood is 0.0031 with a range of virtually zero to 0.5748. The mean predicted risk of getting sick from eating seafood with the hypothetical seafood inspection program is virtually zero with a range of zero to 0.0001. Because the predicted risk with the seafood inspection program is so small, we adopt the empirical model that employs the risk change variable. The mean change in risk is equal to the negative of the baseline risk with small differences at four places beyond the decimal.

Forty-seven percent of the sample found the information helpful when understanding Pfiesteria. Forty-two percent found the hypothetical questions easy to answer. Thirty percent read the information closely and 63% read all of it. Thirty-four percent of the sample had the information with them when they answered the survey questions. Fifty-one percent of the sample found the information about the seafood inspection program to be very clear.

The average number of years the respondent lived in the state of residence is 30 and the average age is 46 years. The average number of years schooling is 14.5. The average number of children is .73. Seventy-six percent of the sample is white and 37% is male.

Thirty-four percent of the sample is concerned about Pfiesteria, 23% have reduced their seafood consumption in the past, and 53% would reduce their seafood consumption in the future with a Pfiesteria outbreak. Twenty percent, 61%, and 13% of respondents think that it is safe to swim, breathe, and eat with Pfiesteria outbreaks.

A summary of the dependent variables is presented in Table 8-3. Eighty-five percent of the respondents who were presented with the $1 price change voted for the seafood inspection program. Eighty percent, 74%, and 65% of the respondents voted for the seafood inspection program when the price change rose to $3, $5, and $7. These differences are statistically significant at the p=.10 level ($\chi^2$=23.47[3 df]). Sixty-nine percent of the sample were very sure about their vote. When only those respondents who were very sure about their "for" response are coded as a "for" response and those who are unsure about their "for" vote are coded as "against," the percentage of "for" votes falls. Sixty-four percent, 60%, 56%, and 49% of the respondents who were very sure voted for the seafood inspection program when the price was $1, $3, $5, and $7. These differences are statistically significant at the p=.05 level ($\chi^2$=9.12[3 df]).

Empirical Results

We estimate the factors that explain the variation in the "for" and "against" votes with the probit regression model (Table 8-4). We estimate four models. The first model, Model 1, includes only the independent variables suggested by economic theory and state dummy variables. Model 2 includes these variables and the information variables. Model 3 includes these variables and the demographic vector. Model 4 includes these variables and the attitudinal and behavior variables.

Since only 41.6% of the respondents to the first survey are included in the willingness to pay sample there is the possibility of sample selection bias. Two conditions are necessary for sample selection bias. The first is that respondents follow some empirical rule when deciding whether to respond to the second survey. In our case, this empirical rule exists (see Chapter 4). For example, respondents who had heard about Pfiesteria are more likely to respond to the second survey. The second necessary condition for sample selection bias is that the sample selection rule is related to unobservable factors that affect willingness to pay.

We test for sample selection bias with the bivariate probit model. Evidence of sample selection bias exists if the correlation between error terms in the referendum probit and the sample selection probit is not significantly different from zero. We find that this correlation is statistically significant in only one of the four models in Table 8-4. In Model 3 the correlation between error terms is significantly different from zero at the p=.05 level. We present the results of this model in Table 8-6. The models presented in Tables 8-4 and 8-5 do not include the sample selection bias correction.

*Baseline Results*

In Model 1 the effect of the price change on the probability of a vote for the seafood inspection program is negative and statistically significant. This result is important in that it is a necessary condition for a statistically significant willingness to pay estimate. The Pfiesteria brochure has a positive effect on the probability of a “for” vote. The counter information has a negative effect on the probability. The average price of a seafood meal has a positive effect on the probability. Income has a negative effect on the probability of a “for” response. Virginia residents are more likely to vote for the seafood inspection program. The effect of the risk change is positive but not statistically significant.

Inclusion of the information variables in Model 2 has no effect on the signs or significance levels of the variables included in Model 1. Respondents who found the information helpful in understanding Pfiesteria, those who thought the hypothetical questions were easy to answer, and those who had the information with them at the time of the survey are more likely to vote for the inspection program. The vector of coefficients is statistically significant at the p=.05 level ($\chi^2$=14.60[6 df]).

Demographic variables are included in Model 3. Inclusion of these variables has no effect on the other variables in the model in terms of sign and significance level with one exception. The effect of having the information with the respondent goes from statistically significant at the p=.10 to being insignificant. Men and older respondents are less likely to vote for the seafood inspection program. The vector of coefficients is statistically significant at the p=.01 level ($\chi^2$=39.26[6 df]).

Inclusion of the attitudinal and behavior variables in Model 4 causes the information treatment variables to become insignificant. This is not surprising since the counter information has a negative effect on avoidance behavior and a positive effect on attitudes about swimming (see Chapter 5). Also, the Pfiesteria brochure has a positive effect on attitudes about eating seafood. Among these only the variable measuring reductions in future seafood consumption has a statistically significant coefficient. The vector of attitudinal coefficients is statistically significant at the p=.01 level ($\chi^2$=27.62[6 df]). In spite of this result we conclude that Model 3 is the most appropriate model for two reasons. First, the only statistically significant coefficient is attached to an endogenous variable (REDUCE) and, second, there is potential multicollinearity between the information treatments and attitudinal and behavior variables.

*Extensions*

In Table 8-5 we investigate other hypotheses about the referendum data. In Model 5 we test for differences in the price change coefficient for respondents who believe and do not believe that the seafood inspection program would cause prices to rise. In Model 6 we consider only those respondents who were very sure about their support for the seafood inspection program. In Models 7 and 8 we test for differences in coefficient vectors between North Carolina, and Delaware, Maryland, and Virginia respondents.

The coefficient on the price change variable for those who do not believe the price change would occur is about 40% lower than the coefficient for those who believe the price change scenario (Model 5). This indicates that respondents who do not believe the scenario are more likely to vote for the inspection program and have higher willingness to pay values. However, the differences in the coefficient estimates are not statistically significant. Therefore, we reject Model 5 in favor of Model 3.

In Model 6 we code those respondents who vote for the inspection program but are not very sure about how they would vote as “against” the program. The price change coefficient is still negative but it is not statistically significant. The counter information, Virginia resident, and age coefficients are no longer statistically significant. Respondents who had the survey information with them and found the information about the inspection program to be very clear are more likely to be very sure about their support for the program. Due to the insignificance of the price change variable we prefer Model 3 over Model 6.

In Model 7 we focus on the North Carolina respondents. The Pfiesteria brochure information does not have a statistically significant effect on the likelihood of a “for” vote. The counter information has a negative effect. The income and race coefficients are no longer statistically significant. Other results are consistent with the full sample. Several differences are found in Model 8 for Delaware, Maryland, and Virginia residents. The average seafood price coefficient and the coefficients on the information treatment variables are no longer statistically significant. On the other hand, the risk change and race coefficients are statistically significant at the p=.05 level. The North Carolina and Delaware, Maryland, and Virginia coefficient vectors are statistically different at the p=.10 level ($\chi^2$=35.91[19 df]).

*Willingness to Pay Functions*

Two valuation functions are presented in Table 8-6. The first is from Model 3 in Table 8-5. The second is the same model with the sample selection bias correction. Each coefficient estimate measures the marginal effect of the change in the coefficient on willingness to pay. Elasticities are presented for continuous variables.

The first valuation function indicates that those who received the Pfiesteria brochure and counter information are willing to pay $2.36 more and $2.46 less than others. As the average seafood meal price increases by $1 willingness to pay increases by $.28. The elasticity estimate suggests that a 10% increase in price leads to a .32% increase in willingness to pay. As income increases by 10% willingness to pay decreases by .33%. Virginia residents are willing to pay $2.22 less than others. Respondents who found the mail out information helpful and those who found the hypothetical questions easy to answer are willing to pay $1.81 and $2.38 more than others. Each year that age increases willingness to pay decreases by $.08 for an elasticity of -.038. Male respondents are willing to pay $5.27 less than females.

The marginal effects of the independent variables on willingness to pay in the second valuation function are very similar to those in the first valuation function. For example, those who received the Pfiesteria brochure and counter information are willing to pay $2.25 more and $2.40 less than others. The major difference is the magnitude of the constants. The constant in the first model is almost three times larger than that in the sample selection model. This will have major implications on the willingness to pay estimate.

The average willingness to pay without the sample selection bias correction is $10.76 with a 90% confidence interval of [$8.31, $13.20]. Willingness to pay is greater than the highest change in the price amount offered because more than 50% of respondents would pay the higher price. The willingness to pay estimate with the sample selection bias correction is 60% less and not statistically different from zero.

Discussion

The contingent valuation results contain information about preferences for risk reduction. The effect of income on willingness to pay is negative indicating that risk reduction and income are substitute goods. Given this result and the positive effect of the price variable on willingness to pay, we conclude that the price variable contains information about seafood quality and the seafood demand elasticity increases with the risk reduction. In only one model did we find the effect of the risk change on willingness to pay is positive, as we predicted. In all other models we must conclude that either the risk change variable is measured with significant error, biasing the coefficient estimate downward, or that willingness to pay estimates do not vary with the magnitude of the perceived risk reduction.

The effects of the information treatments on willingness to pay are mixed. We find that the Pfiesteria brochure increases willingness to pay except in the split sample models and in the poorly specified Model 4. The Pfiesteria brochure described Pfiesteria and its potential effects. Respondents who received this information interpreted it in a way that was not intended. Apparently they were frightened by the information and were more likely to vote for the mandatory seafood inspection program. The counter information has negative effects on willingness to pay except in Model 4, the very sure model, and the Delaware, Maryland, and Virginia model. The counter information emphasized that seafood is safe to eat. Those respondents who received the counter information are less likely to be willing to pay for a mandatory seafood inspection program.

We found significant differences between the North Carolina and Delaware, Maryland, and Virginia samples. Notably, the Delaware, Maryland, and Virginia model is the only one in which the risk change variable has a statistically significant effect on willingness to pay. Also, the North Carolina sample is influenced by the counter information but has no income effects. Other differences are only at the level of significance of the coefficient estimates. We have also estimated willingness to pay for both samples. The willingness to pay for the Delaware, Maryland, and Virginia sample is

12.25 while the North Carolina willingness to pay is only $8.54. While the 44% higher North Carolina estimates are potentially significant in an economic sense, the difference is not statistically significant.

In our preferred model we find sample selection bias. With the bias correction the willingness to pay estimate is $4.32 for each seafood meal but this estimate not statistically significant. However, the lack of statistical significance could be an artifact of the sensitivity of the bivariate probit model. For example, in a bivariate probit model with only the price change variable as an independent variable in the referendum model, the willingness to pay estimate is a statistically significant $4.06. The willingness to pay from the bivariate probit Model 1 is $9.78 (p=.01). Recall that this model does not detect sample selection bias.

Without the sample-selection bias correction the willingness to pay estimate is $10.76 for each meal. Considering that the average seafood meal price is $10.33, the increase in consumer surplus resulting from a mandatory seafood inspection program is more than 100% of the price. The magnitude of this estimate is stretches credibility.

Given these concerns the willingness to pay estimates should be aggregated with caution. Nevertheless, it is good practice to perform this exercise. Conservatively assuming a zero willingness to pay for nonrespondents to the second survey, if 41.6% of the 13.08 million residents are willing to pay $10.76 for each meal the aggregate benefits of the mandatory seafood inspection program would be more than $58 million for each meal. Considering that this sample consumes about four meals per month the annual aggregate benefits of the seafood inspection program would be $2.8 billion. Note that this is an underestimate of the total aggregate benefits because of the limited geographic scope of the sample.

References

Cameron, Trudy Ann, and Michelle D. James, "Efficient Estimation Methods for "Closed-ended' Contingent Valuation Surveys," *Review of Economics and Statistics*, vol. 69, no. 2, May 1987, pp. 269-76.

## Chapter 9. The In-Person Survey

In this chapter we present results from the in-person survey. We focus on responses to open-ended follow-up questions since the sample is too small for useful statistical analysis.

Response

The in-person survey was initiated with a telephone interview in June 2001. The telephone interview was identical to the full sample interview. One-hundred sixty interviews were completed with residents of Craven, Onslow, New Hanover, and Pitt Counties, North Carolina. Fifty-eight of these respondents agreed to be interviewed in-person at a date and time of their choosing. All of these respondents were sent the Pfiesteria brochure, the counter information insert, the seafood inspection program insert, and either the major or minor hypothetical fish kill information sheet. Twenty-eight respondents completed the interview. Most interviews were conducted in July, with a few conducted in August and October, and one in November.

The Survey

The follow-up in-person survey was designed to identify any weaknesses in the second telephone survey (See Appendix D for the survey instrument). For example, in contrast with the telephone survey respondents were asked to have the brochure information with them for reference purposes as they answered the questions. If they had misplaced the information, the interviewer provided it for them.

We included visual aids to help respondents formulate their risk perceptions. Respondents were first shown an 8.5" by 11" card displaying four grids illustrating the "chances of getting sick." The grids contained 100 squares with 50, 25, 10, and 1 square(s) filled in with red. The purpose was to help respondents understand percentages. Those respondents who answered that they thought they had less than a 1% chance of getting sick were shown a second card. This was a bar chart with red bars illustrating 1%, 0.1%, 0.01%, 0.001%, and 0.0001% chances of getting sick.. Anecdotal evidence suggests that these visual aids were helpful to respondents. However, they still had difficulty associating numerical values with their risk perceptions. Unfortunately, the sample is too small to generate any empirical conclusions (e.g., increased efficiency of the risk estimates) from these modifications of the survey instrument.

We also asked a number of additional questions, mostly open-ended follow-ups. These were written in response to some of the surprising empirical results described in the preceding chapters. In response to mixed results of the brochure information on seafood safety perceptions and behavior we asked the closed-ended question: "Did the information make you think that eating seafood is safer to eat or less safe to eat?" with an open-ended follow-up "Why did it make you feel this way?"

We were interested in understanding the aspects of the brochure that respondents found particularly helpful and specific problems the brochure created. Respondents who stated that the information sent to them was “very helpful” in terms of understanding Pfiesteria were asked: “What did you find to be the most helpful?” Respondents who stated that the information sent to them was “somewhat helpful,” “not very helpful,” or “not helpful at all” were asked: “What did you find to be the least helpful?”

Since the surveys were purposely conducted during fish kill season, we were interested in learning the type of intervening information the respondents gathered from sources other than the brochure. Respondents who had heard or read anything else about Pfiesteria were asked: “What did you read about?” or “What did you hear?”

The hypothetical fish kills were based on actual fish kills. Therefore, we find it surprising the significant number of respondents who did not think the hypothetical fish kill was realistic. Those respondents who thought the hypothetical fish kill was “somewhat realistic,” “not very realistic,” “or not realistic at all” were asked: “What part did you think is not realistic?”

A significant number of respondents who received the “minor” fish kill scenario considered it a major fish kill. In the in-person survey we randomly assigned the minor and major fish kill scenarios to respondents and those who thought the fish kill was major were asked: “Why do you consider it a major fish kill?”

A significant number of respondents did not think the seafood inspection program insert was “very clear.” In the in-person survey those who thought that it was “somewhat clear,” “not very clear,” or “not clear at all” were asked: “What did you not understand about the seafood inspection program?”

Several follow-up questions were asked to determine the specific difficulties respondents had when answering the questions. Respondents who stated that they understood the hypothetical seafood meal questions “somewhat well,” “not very well,” or “not at all” were asked: “What was the hardest thing to understand?” Respondents who thought these questions were “very hard” or “somewhat hard” were asked: “What made the questions hard to answer?” Respondents who stated they were “somewhat sure,” “not very sure,” or “not sure at all” were asked: “What were you not sure about?”

Results

Ten respondents felt that the brochure information made them feel “safer” about eating seafood (Table 10.1). Six of these respondents provided comments that indicated that the brochure information contradicted preconceived notions about Pfiesteria. For example, respondents stated that it was important not to eat fish with sores, that it is more dangerous to fish than people, and it only lasts a few hours. Twelve respondents felt that the brochure information made them feel “less safe” about eating seafood. Reasons for this response included a lack of trust in the information, a lack of prior knowledge about Pfiesteria, the scientific controversy surrounding Pfiesteria and the pictures contained in the brochure. Six respondents stated that the information did not change their seafood safety perceptions.

A majority (n=18) of respondents found the information to be "very helpful" (Table 10.2). Most of the respondents did not point to a specific part of the survey that was most helpful, preferring to state that the entire brochure was helpful in understanding a difficult subject. Twelve respondents provided comments about what they considered least helpful in the brochure (two respondents provided comments about both most and least helpful aspects of the brochure). Most of these respondents indicated that the information was not new to them or not enough information was provided.

Twelve respondents reported receiving some intervening information from the media (Table 10.3). All had heard about a fish kill. This result suggests that for many respondents in the telephone survey, the survey was salient.

Twelve respondents did not think the hypothetical fish kill was "very realistic" (Table 10.4). The most prevalent reasons were that the number of fish was too high and the percentage of fish with lesions was too high.

As in the second telephone survey, one-half (n=7) of the respondents who received the minor fish kill scenario (n=13) thought that the fish kill was "major" (Table 10.5). Most respondents (n=5) consider 10,000 dead fish to be a large number. All respondents who received the major version consider the fish kill a major event. Most respondents mentioned the large number of fish affected as the reason it is considered a major fish kill. Only a few mentioned the large number of fish with lesions as a reason.

Six respondents had difficulty understanding the seafood inspection program (Table 10.6). Only two respondents indicated that they would prefer more information. Three respondents indicated that they had trouble understanding the hypothetical seafood meal questions due to a lack of effort spent with the brochure (Table 10.7). Three respondents had trouble answering the hypothetical seafood meal questions due to various answer formulation problems. Seven respondents indicated that they were not "very sure" about their answers to the hypothetical questions. Three of these were related to the seafood inspection program information.

Conclusions

Forty-three percent of all respondents considered seafood to be "less safe" after receiving the Pfiesteria brochure. This large number provides some evidence as to why the brochure and counter information treatments had minimal and/or mixed effects in the empirical study. Most respondents consider both the "minor" and "major" hypothetical fish kills to be a major fish kill because of the large number of fish reported killed. This helps explain why the hypothetical fish kill version has little effect on behavior.

# Chapter 10. Conclusions

This report presents and discusses the results from a four state investigation of the economics effects of Pfiesteria related fish kills in the Mid-Atlantic region. In particular, the report focuses on seafood consumer's reaction to reports of a localized fish kill, and the effects of information conveyance and government reaction to perceived risks. The conclusions of the report are summarized as follows:

- *Reports of Pfiesteria-related fish kills result in adverse reactions on the part of seafood consumers*. Obviously this is not a surprising result, but the prevalence of the result across qualitative seafood risk assessments, quantitative seafood risk assessments and reported demand for seafood leads to the conclusion that this result is robust. Further, the robustness of this result provides a reliability and validity check for the survey instrument utilized (Chapter 3) and the subsequent analysis.

- *The relative size of Pfiesteria-related fish kill events has little impact on the risk perceptions or seafood consumption.* The magnitude of the reported fish kill (as distinguished by a major and minor fish kill) is an insignificant determinant in consumers qualitative assessments of seafood risks, quantitative assessments of risk perceptions, seafood demand or willingness to pay for a seafood inspection program. This result is supported by in-person interviews that indicate that half of respondents receiving the smaller fish kill perceived it as a major event. A number of explanations exist for this result, including, a relatively small range of fish kills offered to individuals in the design of the survey, and individuals interpreted both fish kill scenarios as major events.

- *Simple information conveyance mechanisms, in the form of educational brochures sent to seafood consumers, have mixed effects in reducing the economic consequences of reports of Pfiesteria-related fish kill.* The Pfiesteria brochure sent to consumers was designed to be educational, but not influential. The brochure informed individuals on the current state of knowledge regarding the effects of Pfiesteria and the effects on human health and seafood safety. The Pfiesteria brochure is moderately effective in reducing perceived risk using qualitative assessments of perceived risk, but actually increased the perceived risk in quantitative assessments. These countervailing results are surprising and need further study. The Pfiesteria brochure has no effect on the stated changes in the demand for seafood, but increases the consumer willingness to pay for a mandatory seafood inspection and certification program. This increase in willingness to pay indicates that consumers had a significant adverse reaction to the educational brochure. This conclusion is supported by a series of in-person interviews that found that 43% of respondents found seafood to be less safe after viewing the brochure. Given these mixed results, we conclude that simply informing consumers of the current state of thinking regarding Pfiesteria is an ineffective mechanism for reducing the economic impacts of Pfiesteria–related fish kills.

- *Counter-information treatments designed to alleviate misperceptions associated with Pfiesteria related fish-kills have moderate to no effects on the adverse (seafood related) economic effects of a fish-kill.* Counter information treatments that state that seafood is safe as long as it is handled properly and no visible signs of inspection are present are effective in reducing the perceived risks of seafood as measured qualitatively for North Carolina residents, but ineffective for Maryland, Delaware and Washington, D.C. residents. The counter-information has no significant effect on the quantitative risk perception, or the reported demand for seafood, but consumers indicate a decreased willingness to pay for a mandatory seafood inspection program after viewing the counter-information indicating a partial reduction in the perceived risk of seafood.

- *A mandatory seafood inspection program is an effective mechanism for alleviating the economic losses associated with a publicized Pfiesteria-related fish kill.* A hypothetical mandatory seafood inspection program proves to be a robust tool for eliminating the perceived increase in the qualitative risk of seafood associated with a fish-kill, the increase in quantitative risk of seafood associated with a fish-kill, and the reduced demand for seafood. The results of a contingent valuation exercise find that consumers are willing to absorb (on average) a 100% increase in the price of a seafood meal to ensure that the seafood is inspected.

- *The economic effects of a Pfiesteria-related fish-kill are significant.* This report demonstrates that the direct economic effects (in the form of reduced seafood consumption) and indirect effects (in the form of increased perceived risks) of Pfiesteria-related fish kills are substantial. The lost consumer surplus due to a published/reported fish kill is estimated to be between $1.70 and $3.31 per meal if no information, counter information or seafood inspection program is provided to the consumer. Aggregating this number to the population of seafood consumers (13.08 million residents, of which 41.6% seafood consumers eat 4 meals per month on average), the lost consumer surplus due to a fish kill event is $37 million to $72 million in the month following the fish kill. Further evidence of the significance of the lost welfare due to uncertainty regarding the safety of seafood is the respondents' stated willingness to pay of $10.76 per meal for a mandatory seafood inspection and certification program, or $2.8 billion annually. The estimated welfare improvements derived from the seafood inspection program are broader in scope than Pfiesteria-related fish-kill events. This figure is significantly higher than the estimated welfare losses associated with a fish kill, and represents a willingness to pay estimate for general seafood safety. This includes uncertainty about safety in relation to Pfiesteria, and other safety concerns.

## Tables

## Chapter 4. Tables

**Table 4-1: Experimental Design**

| Sub Sample | Fish Kill Insert | Brochure | Counter Information | Target Sample | Sample Location |
|---|---|---|---|---|---|
| 1 | Minor MD | Yes | Yes | 200 | DE, DC, MD VA |
| 2 | Major MD | Yes | Yes | 200 | DE, DC, MD VA |
| 3 | Minor MD | Yes | | 200 | DE, DC, MD VA |
| 4 | Major MD | Yes | | 200 | DE, DC, MD VA |
| 5 | Minor MD | | | 100 | DE, DC, MD VA |
| 6 | Major MD | | | 100 | DE, DC, MD VA |
| 7 | Minor NC | Yes | Yes | 200 | NC |
| 8 | Major NC | Yes | Yes | 200 | NC |
| 9 | Minor NC | Yes | | 200 | NC |
| 10 | Major NC | Yes | | 200 | NC |
| 11 | Minor NC | | | 100 | NC |
| 12 | Major NC | | | 100 | NC |

**Table 4-2: Sample Report**

| Description | First Survey | Second Survey |
|---|---|---|
| Complete | 1807 | 846 |
| Partial | 11 | 6 |
| Eligible: Hard Refusal | 569 | 147 |
| Eligible: Soft Refusal | 585 | 31 |
| Eligible: Break Off | 1 | 0 |
| Eligible: Resp Never Available | 45 | 30 |
| Eligible: Ans. Mach, No Message | 485 | 8 |
| Eligible: Dead | 1 | 3 |
| Eligible: Phys/Mentally Unable | 52 | 9 |
| Eligible: Language Unable | 56 | 0 |
| Eligible: Miscellaneous Unable | 13 | 5 |
| Busy | 102 | 15 |
| No Answer | 1023 | 0 |
| Technical Problems | 139 | 1 |
| Fax/Data Line | 468 | 10 |
| Non-working Number | 126 | 15 |
| Disconnected Number | 1148 | 22 |
| Number Changed | 47 | 39 |
| Cell Phone | 42 | 4 |
| Call Forwarding | 8 | 0 |
| Business/Govt/Other | 918 | 8 |
| Institution | 26 | 0 |
| Group Quarter | 12 | 0 |
| No Eligible Respondent | 1187 | 82 |
| Callback, Respondent Not Selected | 14 | 18 |
| Callback, Respondent Selected | 7 | 101 |
| Total Attempted | 8892 | 1403 |

**Table 4-3: Income Regression Model**

Dependent Variable = ln(INCOME)

| Variable | Coefficient | t-value |
|---|---|---|
| INTERCEPT | 1.852 | 18.37 |
| EDUC | 0.083 | 15.14 |
| EXPERIENCE | 0.022 | 8.25 |
| $EXPERIENCE^2$ | -0.00038 | -9.02 |
| MALE | 0.188 | 6.06 |
| WHITE | 0.147 | 5.13 |
| HOUSE | 0.169 | 9.82 |
| CHILDREN | -0.125 | -5.67 |
| Adjusted $R^2$ | 0.27 | |
| F Value | 84.22 | |
| Sample Size | 1538 | |

**Table 4-4: Frequencies of Income Variable**

| | Without Imputed Values | | With Imputed Values | |
|---|---|---|---|---|
| INCOME | Frequency | Percent | Frequency | Percent |
| 5 | 40 | 2.6 | 46 | 2.6 |
| 15 | 93 | 6.0 | 107 | 6.0 |
| 25 | 196 | 12.7 | 263 | 14.7 |
| 35 | 217 | 14.1 | 319 | 17.8 |
| 40 | 113 | 7.3 | 113 | 6.3 |
| 45 | 190 | 12.4 | 235 | 13.1 |
| 62.5 | 341 | 22.2 | 361 | 20.1 |
| 87.5 | 181 | 11.8 | 182 | 10.2 |
| 100 | 167 | 10.9 | 167 | 9.3 |

**Table 4-5: Demographic Variables**

| Variable | Unweighted Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|
| AGE | 46.87 | 17.05 | 18 | 100 |
| MALE | 0.36 | 0.48 | 0 | 1 |
| WHITE | 0.71 | 0.45 | 0 | 1 |
| HOUSE | 2.72 | 1.37 | 0 | 8 |
| CHILDREN | 0.72 | 1.05 | 0 | 5 |
| EDUC | 14.17 | 2.68 | 0 | 20 |
| INCOME | 50.12 | 25.96 | 5 | 100 |
| STATE | 31.25 | 21.16 | 0 | 88 |
| LENGTH | 24.31 | 19.96 | 0 | 88 |

| Variable | Weighted Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|
| AGE | 46.69 | 17.47 | 18 | 100 |
| MALE | 0.37 | 0.48 | 0 | 1 |
| WHITE | 0.65 | 0.48 | 0 | 1 |
| HOUSE | 2.69 | 1.39 | 0 | 8 |
| CHILDREN | 0.70 | 1.05 | 0 | 5 |
| EDUC | 14.58 | 2.77 | 0 | 20 |
| INCOME | 53.61 | 26.77 | 5 | 100 |
| STATE | 29.80 | 20.31 | 0 | 88 |
| LENGTH | 22.29 | 18.76 | 0 | 88 |

**Table 4-6: Comparison of Means Across Sample**

| Variable | DE | MD/DC | NC | VA |
|---|---|---|---|---|
| AGE | 45.68 | 47.40 | 47.32 | 45.54 |
| MALE | 0.43 | 0.37 | 0.35 | 0.37 |
| WHITE | 0.80 | 0.57 | 0.74 | 0.66 |
| HOUSE | 2.87 | 2.67 | 2.70 | 2.67 |
| CHILDREN | 0.77 | 0.67 | 0.73 | 0.72 |
| EDUC | 14.18 | 14.73 | 13.98 | 14.92 |
| INCOME | 53.93 | 55.21 | 47.64 | 56.00 |
| STATE | 26.82 | 29.95 | 33.04 | 27.77 |
| LENGTH | 25.23 | 23.54 | 24.4 | 18.7 |
| Sample Size | 236 | 264 | 1073 | 220 |

**Table 4-7: Comparison of Means Across First and Second Survey**

| Variable | First | Second |
|---|---|---|
| AGE | 46.86 | 46.88 |
| MALE | 0.35 | 0.36 |
| WHITE | 0.66 | 0.77 |
| HOUSE | 2.75 | 2.68 |
| CHILDREN | 0.74 | 0.70 |
| EDUC | 13.87 | 14.50 |
| INCOME | 47.88 | 52.68 |
| STATE | 31.51 | 30.96 |
| LENGTH | 24.40 | 24.20 |
| Sample Size | 958 | 835 |

**Table 4-8: Do you eat seafood …?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| OFTEN | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| About once or twice a year | 13 | 5.5 | 13 | 4.9 | 60 | 5.6 | 11 | 5.0 |
| About once or twice a month | 107 | 45.3 | 99 | 37.5 | 525 | 48.9 | 97 | 44.1 |
| About once a week | 71 | 30.1 | 93 | 35.2 | 339 | 31.6 | 68 | 30.9 |
| More than once a week | 45 | 19.1 | 59 | 22.3 | 149 | 13.9 | 44 | 20.0 |
| Sample Size | 236 | | 264 | | 1073 | | 220 | |

**Table 4-9: About how many seafood meals did you eat last month?**

DE

| Variable | Sample | Mean | StdDev | Minimum | Maximum |
|---|---|---|---|---|---|
| NUMBER1 | 236 | 5.54 | 6.11 | 0 | 40 |
| TYPICAL | 236 | 0.81 | 0.39 | 0 | 1 |
| TYPMONTH | 44 | 2.70 | 2.97 | 0 | 15 |

MD/DC

| Variable | Sample | Mean | StdDev | Minimum | Maximum |
|---|---|---|---|---|---|
| NUMBER1 | 264 | 5.99 | 6.03 | 0 | 56 |
| TYPICAL | 264 | 0.83 | 0.37 | 0 | 1 |
| TYPMONTH | 44 | 4.00 | 3.63 | 0 | 15 |

NC

| Variable | Sample | Mean | StdDev | Minimum | Maximum |
|---|---|---|---|---|---|
| NUMBER1 | 1073 | 4.09 | 4.02 | 0 | 56 |
| TYPICAL | 1073 | 0.83 | 0.38 | 0 | 1 |
| TYPMONTH | 185 | 2.33 | 2.22 | 0 | 15 |

VA

| Variable | Sample | Mean | StdDev | Minimum | Maximum |
|---|---|---|---|---|---|
| NUMBER1 | 220 | 4.89 | 4.65 | 0 | 31 |
| TYPICAL | 220 | 0.80 | 0.40 | 0 | 1 |
| TYPMONTH | 43 | 2.81 | 2.59 | 0 | 12 |

**Table 4-10: Did you eat any finfish, shellfish, or both?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| TYPES | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Finfish | 46 | 19.5 | 45 | 17.2 | 230 | 21.6 | 39 | 17.7 |
| Shellfish | 50 | 21.2 | 38 | 14.5 | 189 | 17.8 | 37 | 16.8 |
| Both | 140 | 59.3 | 179 | 68.3 | 645 | 60.6 | 144 | 65.5 |
| Sample Size | 236 | | 262 | | 1064 | | 220 | |

**Table 4-11: Types of Seafood Meals**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| Variable | Sample | Mean | Sample | Mean | Sample | Mean | Sample | Mean |
| FINFISH | 182 | 3.93 | 221 | 3.91 | 879 | 2.95 | 181 | 3.42 |
| NUMSHELL | 186 | 3.58 | 216 | 3.32 | 839 | 2.68 | 179 | 2.93 |
| RESTAU | 235 | 2.49 | 263 | 2.67 | 1070 | 2.29 | 220 | 2.26 |
| OWNHOME | 233 | 2.97 | 263 | 3.06 | 1070 | 1.90 | 220 | 2.62 |
| VENDOR | 171 | 0.26 | 190 | 0.30 | 608 | 0.15 | 142 | 0.05 |
| MARKET | 171 | 1.95 | 190 | 1.98 | 608 | 1.53 | 142 | 1.63 |
| GROCERY | 170 | 1.62 | 191 | 2.07 | 605 | 1.19 | 142 | 1.96 |
| FROZEN | 169 | 0.53 | 189 | 0.56 | 606 | 0.34 | 142 | 0.39 |
| FISH | 170 | 0.96 | 190 | 0.62 | 610 | 0.65 | 142 | 0.60 |

**Table 4-12: What kinds of finfish did you eat?**

| KINDFIN | Frequency | Percent |
|---|---|---|
| Bass (largemouth, smallmouth) | 14 | 0.95 |
| Bass (sea) | 26 | 1.77 |
| Bluefish | 32 | 2.18 |
| Carp | 4 | 0.27 |
| Catfish | 133 | 9.04 |
| Cod | 66 | 4.49 |
| Croaker | 98 | 6.66 |
| Flounder | 644 | 43.78 |
| Grouper | 52 | 3.54 |
| King Mackerel | 21 | 1.43 |
| Mahi Mahi | 49 | 3.33 |
| Mullet | 13 | 0.88 |
| Perch | 33 | 2.24 |
| Orange Roughy | 24 | 1.63 |
| Pollock | 14 | 0.95 |
| Pompano | 2 | 0.14 |
| Red Drum (redfish) | 8 | 0.54 |
| Rockfish (striped bass) | 39 | 2.65 |
| Salmon | 300 | 20.39 |
| Shark | 12 | 0.82 |
| Snapper (red, etc.) | 17 | 1.16 |
| Sole | 8 | 0.54 |
| Spanish Mackerel | 19 | 1.29 |
| Spot | 91 | 6.19 |
| Sushi | 11 | 0.75 |
| Swordfish | 44 | 2.99 |
| Tilapia | 18 | 1.22 |
| Trout (saltwater) | 175 | 11.90 |
| Trout (freshwater) | 130 | 8.84 |
| Tuna | 179 | 12.17 |
| Whitefish | 40 | 2.72 |
| Whiteing | 64 | 4.35 |
| Other | 76 | 5.17 |
| Don't Know | 109 | 7.41 |

**Table 4-13: What kinds of shellfish did you eat?**

| KINDSHE | Frequency | Percent |
|---|---|---|
| Clams | 177 | 12.43 |
| Crabs | 529 | 37.15 |
| Crayfish | 9 | 0.63 |
| Lobster | 132 | 9.27 |
| Mussels | 54 | 3.79 |
| Octopus | 6 | 0.42 |
| Oysters | 250 | 17.56 |
| Scallops | 184 | 12.92 |
| Shrimp | 1040 | 73.03 |
| Squid (Calamari) | 6 | 0.42 |
| Other | 7 | 0.49 |
| Don't Know | 94 | 6.60 |

**Table 4-14: How was the finfish/shellfish cooked?**

| | COOK | | SHELCOOK | |
|---|---|---|---|---|
| | Frequency | Percent | Frequency | Percent |
| Baked | 260 | 17.68 | 68 | 4.77 |
| Blackened | 33 | 2.24 | 4 | 0.28 |
| Boiled | 45 | 3.06 | 271 | 18.99 |
| Broiled | 320 | 21.75 | 211 | 14.79 |
| Fried | 802 | 54.52 | 610 | 42.75 |
| Grilled | 270 | 18.35 | 65 | 4.56 |
| Raw | 17 | 1.16 | 37 | 2.59 |
| Smoked | 9 | 0.61 | 4 | 0.28 |
| Steamed | 27 | 1.84 | 469 | 32.87 |
| Stewed | 11 | 0.75 | 22 | 1.54 |
| Other | 36 | 2.45 | 80 | 5.61 |
| Don't Know | 75 | 5.10 | 97 | 6.80 |

**Table 4-15: Effect of Start Cost on Final Cost**

| | Home Cost | | Restaurant Cost | |
|---|---|---|---|---|
| Variable | Coeff. | t-value | Coeff. | t-value |
| INTERCEPT | 7.19 | 14.31 | 11.78 | 22.62 |
| Starting Cost | 1.19 | 4.27 | 1.32 | 4.38 |
| Percent Finfish | -1.67 | -3.93 | -1.11 | -2.52 |
| Adjusted $R^2$ | 0.031 | | 0.018 | |
| F-value | 17.02 | | 12.88 | |
| Sample Size | 997 | | 1289 | |

**Table 4-16: Imputation Model for Meals Variable**

| | Home Cooked | | Restaurant | |
|---|---|---|---|---|
| Variable | Coeff. | t-value | Coeff. | t-value |
| INTERCEPT | 0.61 | 11.43 | 0.58 | 11.09 |
| Residual[a] | 0.75 | 62.19 | 0.75 | 65.81 |
| Adjusted R2 | 0.68 | | 0.71 | |
| F-value | 3868 | | 4330 | |
| Sample Size | 1785 | | 1785 | |

[a]NUMBER1 minus restaurant meals and minus home-cooked meals.

**Table 4-17: Imputed Home-Cooked and Restaurant Meals**

| | OWNHOME | | RESTAU | | |
|---|---|---|---|---|---|
| Observation | Actual | Imputed | Actual | Imputed | NUMBER1 |
| 1 | 0 | | . | 1 | 0 |
| 2 | 3 | | . | 1 | 3 |
| 3 | 2 | | . | 1 | 2 |
| 4 | 3 | | . | 6 | 10 |
| 5 | . | 3 | 0 | | 3 |
| 6 | . | 2 | 2 | | 4 |
| 7 | . | 6 | 0 | | 7 |
| 8 | 4 | | . | 1 | 5 |
| 9 | . | 1 | 2 | | 2 |
| 10 | . | 1 | 2 | | 3 |
| 11 | . | 1 | 10 | | 10 |
| 12 | . | 2 | 0 | | 2 |
| 13 | 0 | 1 | 0 | 2 | 3 |
| 14 | 0 | 1 | 0 | 0 | 0 |
| 15 | 0 | 1 | 0 | 1 | 1 |
| 16 | 0 | 1 | 0 | 0 | 0 |
| 17 | 0 | 1 | 0 | 1 | 2 |
| 18 | 0 | 1 | 0 | 1 | 2 |
| 19 | 0 | 1 | 0 | 1 | 2 |
| 20 | 0 | 1 | 0 | 0 | 0 |
| 21 | 0 | 1 | 0 | 1 | 1 |
| 22 | 0 | 1 | 0 | 1 | 1 |
| 23 | 0 | 1 | 0 | 0 | 0 |
| 24 | 0 | 2 | 0 | 2 | 5 |
| 25 | 0 | 1 | 0 | 1 | 1 |
| 26 | 0 | 2 | 0 | 2 | 4 |
| 27 | 0 | 1 | 0 | 1 | 1 |
| 28 | 0 | 7 | 0 | 9 | 20 |
| 29 | 0 | 1 | 0 | 2 | 3 |
| 30 | 0 | 1 | 0 | 2 | 3 |
| 31 | 0 | 1 | 0 | 1 | 1 |
| 32 | 0 | 1 | 0 | 0 | 0 |
| 33 | 0 | 2 | 0 | 2 | 4 |

**Table 4-17 Continued**

| | OWNHOME | | RESTAU | | |
|---|---|---|---|---|---|
| Observation | Actual | Impute | Actual | Imputed | NUMBER1 |
| 34 | 0 | 1 | 0 | 1 | 1 |
| 35 | 0 | 1 | 0 | 1 | 2 |
| 36 | 0 | 1 | 0 | 0 | 0 |
| 37 | 0 | 1 | 0 | 1 | 2 |
| 38 | 0 | 3 | 0 | 4 | 8 |
| 39 | 0 | 1 | 0 | 1 | 1 |
| 40 | 0 | 2 | 0 | 3 | 6 |
| 41 | 0 | 1 | 0 | 1 | 1 |
| 42 | 0 | 1 | 0 | 1 | 2 |
| 43 | 0 | 2 | 0 | 2 | 5 |
| 44 | 0 | 1 | 0 | 0 | 0 |
| 45 | 0 | 1 | 0 | 1 | 1 |
| 46 | 0 | 1 | 0 | 1 | 1 |
| 47 | 0 | 6 | 0 | 7 | 16 |
| 48 | 0 | 1 | 0 | 1 | 1 |
| 49 | 0 | 1 | 0 | 1 | 2 |
| 50 | 0 | 1 | 0 | 2 | 3 |
| 51 | 0 | 1 | 0 | 1 | 1 |
| 52 | 0 | 1 | 0 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 | 0 |

**Table 4-18: Frequency of Weighted Average Seafood Prices**

| AVGPRICE | Frequency | Percent |
|---|---|---|
| 1 | 10 | 0.6 |
| 2 | 11 | 0.6 |
| 3 | 32 | 1.8 |
| 4 | 38 | 2.1 |
| 5 | 129 | 7.2 |
| 6 | 97 | 5.4 |
| 7 | 125 | 7.0 |
| 8 | 185 | 10.3 |
| 9 | 242 | 13.5 |
| 10 | 137 | 7.6 |
| 11 | 153 | 8.5 |
| 12 | 96 | 5.3 |
| 13 | 170 | 9.5 |
| 14 | 53 | 2.9 |
| 15 | 75 | 4.2 |
| 16 | 31 | 1.7 |
| 17 | 41 | 2.3 |
| 18 | 26 | 1.4 |
| 19 | 13 | 0.7 |
| 20 | 44 | 2.4 |
| 21 | 22 | 1.2 |
| 22 | 6 | 0.3 |
| 23 | 4 | 0.2 |
| 24 | 8 | 0.4 |
| 25 | 17 | 0.9 |
| 26 | 32 | 1.8 |

**Table 4-19: Hypothetical Seafood Meals**

| | | DE | |
|---|---|---|---|
| Variable | N | Mean | Std Dev |
| NUMBER2 | 223 | 5.81 | 6.31 |
| NUMBER3 | 225 | 4.59 | 5.77 |
| NUMBER4 | 232 | 7.30 | 7.36 |

| | | MD | |
|---|---|---|---|
| Variable | N | Mean | Std Dev |
| NUMBER2 | 257 | 5.90 | 6.11 |
| NUMBER3 | 255 | 4.84 | 5.68 |
| NUMBER4 | 259 | 7.07 | 6.57 |

| | | NC | |
|---|---|---|---|
| Variable | N | Mean | Std Dev |
| NUMBER2 | 1037 | 4.17 | 4.18 |
| NUMBER3 | 1028 | 3.28 | 3.98 |
| NUMBER4 | 1043 | 5.10 | 4.74 |

| | | VA | |
|---|---|---|---|
| Variable | N | Mean | Std Dev |
| NUMBER2 | 215 | 5.02 | 5.23 |
| NUMBER3 | 214 | 4.00 | 4.93 |
| NUMBER4 | 215 | 6.29 | 5.96 |

**Table 4-20: Differences in NUMBER3 and NUMBER4 by Price Change**

NUMBER3

| PRICEUP | N | Mean | Std Dev |
|---|---|---|---|
| 1 | 416 | 4.29 | 4.49 |
| 3 | 441 | 4.04 | 5.02 |
| 5 | 439 | 3.28 | 4.05 |
| 7 | 426 | 3.50 | 5.06 |

NUMBER4

| PRICDOWN | N | Mean | Std Dev |
|---|---|---|---|
| 1 | 424 | 5.22 | 5.32 |
| 2 | 435 | 5.60 | 5.28 |
| 3 | 442 | 6.32 | 6.52 |
| 4 | 448 | 6.15 | 5.39 |

**Table 4-21: Do you think seafood … to eat?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| SAFE | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very safe | 91 | 40.44 | 104 | 40.47 | 416 | 39.81 | 91 | 43.33 |
| Somewhat safe | 120 | 53.33 | 133 | 51.75 | 552 | 52.82 | 108 | 51.43 |
| Somewhat unsafe | 12 | 5.33 | 18 | 7.00 | 65 | 6.22 | 10 | 4.76 |
| Very unsafe | 2 | 0.89 | 2 | 0.78 | 12 | 1.15 | 1 | 0.48 |
| Total | 225 | | 257 | | 1045 | | 210 | |

**Table 4-22: What do you think are your chances of getting sick from eating these (NUMBER2) meals?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| CHANCE | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very likely | 2 | 0.87 | 5 | 1.91 | 16 | 1.52 | 4 | 1.83 |
| Somewhat likely | 12 | 5.19 | 27 | 10.31 | 120 | 11.43 | 16 | 7.34 |
| Somewhat not likely | 57 | 24.68 | 58 | 22.14 | 220 | 20.95 | 47 | 21.56 |
| Not likely at all | 160 | 69.26 | 172 | 65.65 | 694 | 66.10 | 151 | 69.27 |
| Total | 231 | | 262 | | 1050 | | 218 | |

**Table 4-23: Which food do you think is most likely to make you sick?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| SICKMOST | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Seafood | 43 | 23.50 | 50 | 23.70 | 193 | 22.79 | 37 | 22.29 |
| Poultry | 87 | 47.54 | 80 | 37.91 | 424 | 50.06 | 75 | 45.18 |
| Meat | 53 | 28.96 | 81 | 38.39 | 230 | 27.15 | 54 | 32.53 |
| Total | 183 | | 211 | | 847 | | 166 | |

**Table 4-24: Which food do you think is least likely to make you sick?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| SICKLEAS | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Seafood | 62 | 32.29 | 79 | 36.74 | 315 | 35.75 | 57 | 32.57 |
| Poultry | 44 | 22.92 | 56 | 26.05 | 203 | 23.04 | 54 | 30.86 |
| Meat | 86 | 44.79 | 80 | 37.21 | 363 | 41.20 | 64 | 36.57 |
| Total | 192 | | 215 | | 881 | | 175 | |

**Table 4-25: Do you think your changes are greater or less than 1%?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| PERCENT | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Greater | 29 | 12.83 | 28 | 11.20 | 125 | 12.05 | 16 | 7.51 |
| Less | 141 | 62.39 | 152 | 60.80 | 632 | 60.95 | 126 | 59.15 |
| About 1% | 56 | 24.78 | 70 | 28.00 | 280 | 27.00 | 71 | 33.33 |
| Total | 226 | | 250 | | 1037 | | 213 | |

**Table 4-26: Do you think your chances are greater or less than RISK1?**

| | RISK1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.000001 | | 0.00001 | | 0.0001 | | 0.001 | |
| CHANCE_A | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Greater | 82 | 33.47 | 57 | 22.27 | 41 | 18.30 | 39 | 15.79 |
| Less | 110 | 44.90 | 159 | 62.11 | 128 | 57.14 | 164 | 66.40 |
| About RISK1 | 53 | 21.63 | 40 | 15.63 | 55 | 24.55 | 44 | 17.81 |
| Total | 245 | | 256 | | 224 | | 247 | |

**Table 4-27: How concerned are you about poor seafood handling practices?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| HANDLING | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very concerned | 93 | 41.15 | 123 | 47.49 | 504 | 48.00 | 95 | 44.60 |
| Somewhat concerned | 83 | 36.73 | 77 | 29.73 | 354 | 33.71 | 83 | 38.97 |
| Not concerned | 50 | 22.12 | 59 | 22.78 | 192 | 18.29 | 35 | 16.43 |
| Total | 226 | | 259 | | 1050 | | 213 | |

**Table 4-28: How concerned are you about the freshness of seafood?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| FRESH | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very concerned | 149 | 64.22 | 172 | 65.40 | 718 | 67.35 | 139 | 64.95 |
| Somewhat concerned | 51 | 21.98 | 66 | 25.10 | 249 | 23.36 | 52 | 24.30 |
| Not concerned | 32 | 13.79 | 25 | 9.51 | 99 | 9.29 | 23 | 10.75 |
| Total | 232 | | 263 | | 1066 | | 214 | |

**Table 4-29: How concerned are you about diseases in fish?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| DISEASE | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very concerned | 121 | 52.16 | 146 | 56.15 | 597 | 56.70 | 102 | 47.89 |
| Somewhat concerned | 69 | 29.74 | 73 | 28.08 | 285 | 27.07 | 68 | 31.92 |
| Not concerned | 43 | 18.53 | 41 | 15.77 | 171 | 16.24 | 43 | 20.19 |
| Total | 232 | | 260 | | 1053 | | 213 | |

**Table 4-30: Have you ever heard about Pfiesteria?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| PFIESTER | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Yes | 182 | 77.12 | 214 | 81.37 | 742 | 69.67 | 152 | 69.41 |
| No | 54 | 22.88 | 49 | 18.63 | 323 | 30.33 | 67 | 30.59 |
| Total | 236 | | 263 | | 1065 | | 219 | |

**Table 4-31: Would you say that Pfiesteria is a …?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| PFIEST | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Form of pollution | 27 | 19.42 | 52 | 29.21 | 163 | 28.70 | 16 | 14.41 |
| Disease in fish | 12 | 8.63 | 26 | 14.61 | 81 | 14.26 | 19 | 17.12 |
| Toxic organism | 56 | 40.29 | 54 | 30.34 | 180 | 31.69 | 47 | 42.34 |
| Predator that attacks fish | 4 | 2.88 | 4 | 2.25 | 17 | 2.99 | 1 | 0.90 |
| Parasite in fish | 40 | 28.78 | 42 | 23.60 | 127 | 22.36 | 28 | 25.23 |
| Total | 139 | | 178 | | 568 | | 111 | |

**Table 4-32: Have outbreaks of Pfiesteria occurred in [state] during the past month?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| OUTBREAK | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Yes | 47 | 32.64 | 31 | 16.32 | 159 | 27.13 | 11 | 9.17 |
| No | 97 | 67.36 | 159 | 83.68 | 427 | 72.87 | 109 | 90.83 |
| Total | 144 | | 190 | | 586 | | 120 | |

**Table 4-33: How concerned are you about Pfiesteria?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| CONCERN | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very concerned | 80 | 44.20 | 104 | 48.37 | 353 | 47.96 | 63 | 42.00 |
| Somewhat concerned | 63 | 34.81 | 70 | 32.56 | 280 | 38.04 | 56 | 37.33 |
| Not concerned | 38 | 20.99 | 41 | 19.07 | 103 | 13.99 | 31 | 20.67 |
| Total | 181 | | 215 | | 736 | | 150 | |

**Table 4-34: Have you ever avoided eating seafood because of Pfiesteria outbreaks?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| AVOID | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Yes | 49 | 27.84 | 82 | 38.14 | 213 | 29.02 | 41 | 27.15 |
| No | 127 | 72.16 | 133 | 61.86 | 521 | 70.98 | 110 | 72.85 |
| Total | 176 | | 215 | | 734 | | 151 | |

**Table 4-35: Would a Pfiesteria outbreak in [state] next week reduce the number of seafood meals that you would next month?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| REDUCE | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Yes | 100 | 58.14 | 131 | 62.68 | 490 | 69.01 | 97 | 64.67 |
| No | 72 | 41.86 | 78 | 37.32 | 220 | 30.99 | 53 | 35.33 |
| Total | 172 | | 209 | | 710 | | 150 | |

**Table 4-36: It is safe to swim in coastal waters during a Pfiesteria outbreak.**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| SWIM | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Strongly agree | 6 | 3.37 | 9 | 4.23 | 17 | 2.28 | 4 | 2.65 |
| Agree | 24 | 13.48 | 20 | 9.39 | 91 | 12.18 | 20 | 13.25 |
| Disagree | 83 | 46.63 | 107 | 50.23 | 393 | 52.61 | 75 | 49.67 |
| Strongly disagree | 43 | 24.16 | 61 | 28.64 | 186 | 24.90 | 40 | 26.49 |
| Uncertain | 22 | 12.36 | 16 | 7.51 | 60 | 8.03 | 12 | 7.95 |
| Total | 178 | | 213 | | 747 | | 151 | |

**Table 4-37: It is safe to breathe the air around coastal waters during a Pfiesteria outbreak.**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| BREATHE | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Strongly agree | 16 | 8.89 | 20 | 9.39 | 55 | 7.50 | 8 | 5.26 |
| Agree | 96 | 53.33 | 106 | 49.77 | 353 | 48.16 | 83 | 54.61 |
| Disagree | 36 | 20.00 | 44 | 20.66 | 167 | 22.78 | 29 | 19.08 |
| Strongly disagree | 3 | 1.67 | 6 | 2.82 | 32 | 4.37 | 5 | 3.29 |
| Uncertain | 29 | 16.11 | 34 | 15.96 | 126 | 17.19 | 27 | 17.76 |
| Total | 180 | | 213 | | 733 | | 152 | |

**Table 4-38: It is safe to eat seafood from an area where a Pfiesteria outbreak has happened.**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| EAT | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Strongly agree | 4 | 2.20 | 1 | 0.47 | 14 | 1.87 | 2 | 1.32 |
| Agree | 21 | 11.54 | 12 | 5.61 | 37 | 4.95 | 13 | 8.55 |
| Disagree | 76 | 41.76 | 109 | 50.93 | 369 | 49.40 | 72 | 47.37 |
| Strongly disagree | 64 | 35.16 | 75 | 35.05 | 275 | 36.81 | 59 | 38.82 |
| Uncertain | 17 | 9.34 | 17 | 7.94 | 52 | 6.96 | 6 | 3.95 |
| Total | 182 | | 214 | | 747 | | 152 | |

**Table 4-39: Pollution from farms can cause Pfiesteria outbreaks.**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| FARMS | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Strongly agree | 19 | 10.73 | 34 | 15.89 | 86 | 11.65 | 15 | 9.93 |
| Agree | 84 | 47.46 | 111 | 51.87 | 382 | 51.76 | 83 | 54.97 |
| Disagree | 29 | 16.38 | 22 | 10.28 | 78 | 10.57 | 9 | 5.96 |
| Strongly disagree | 4 | 2.26 | 4 | 1.87 | 5 | 0.68 | 2 | 1.32 |
| Uncertain | 41 | 23.16 | 43 | 20.09 | 187 | 25.34 | 42 | 27.81 |
| Total | 177 | | 214 | | 738 | | 151 | |

**Table 4-40: Pollution from factories can cause Pfiesteria outbreaks.**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| FACTORY | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Strongly agree | 21 | 11.93 | 29 | 13.62 | 81 | 10.89 | 14 | 9.27 |
| Agree | 88 | 50.00 | 97 | 45.54 | 388 | 52.15 | 73 | 48.34 |
| Disagree | 23 | 13.07 | 24 | 11.27 | 81 | 10.89 | 19 | 12.58 |
| Strongly disagree | 3 | 1.70 | 4 | 1.88 | 7 | 0.94 | 3 | 1.99 |
| Uncertain | 41 | 23.30 | 59 | 27.70 | 187 | 25.13 | 42 | 27.81 |
| Total | 176 | | 213 | | 744 | | 151 | |

**Table 4-41: Did you read … ?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| AMOUNT | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| All of it | 66 | 65.35 | 71 | 65.74 | 323 | 60.83 | 64 | 68.82 |
| Just some of it | 35 | 34.65 | 37 | 34.26 | 208 | 39.17 | 29 | 31.18 |
| Total | 101 | | 108 | | 531 | | 93 | |

**Table 4-42: Did you read it … ?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| CLOSELY | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very closely | 26 | 26.00 | 31 | 28.70 | 157 | 29.57 | 28 | 30.11 |
| Somewhat closely | 60 | 60.00 | 66 | 61.11 | 301 | 56.69 | 54 | 58.06 |
| Not very closely | 13 | 13.00 | 11 | 10.19 | 63 | 11.86 | 10 | 10.75 |
| Not closely at all | 1 | 1.00 | 0 | 0.00 | 10 | 1.88 | 1 | 1.08 |
| Total | 100 | | 108 | | 531 | | 93 | |

**Table 4-43: Do you have the information with you now?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| INFOWITH | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Yes | 41 | 40.59 | 25 | 23.15 | 188 | 35.47 | 27 | 29.03 |
| No | 60 | 59.41 | 83 | 76.85 | 342 | 64.53 | 66 | 70.97 |
| Total | 101 | | 108 | | 530 | | 93 | |

**Table 4-44: Do you eat seafood … ?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| OFTEN2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| About once or twice a year | 6 | 5.94 | 6 | 5.56 | 35 | 6.57 | 4 | 4.30 |
| About once or twice a month | 48 | 47.52 | 43 | 39.81 | 264 | 49.53 | 38 | 40.86 |
| About once a week | 32 | 31.68 | 33 | 30.56 | 158 | 29.64 | 34 | 36.56 |
| More than once a week | 15 | 14.85 | 26 | 24.07 | 76 | 14.26 | 17 | 18.28 |
| Sample Size | 101 | | 108 | | 533 | | 93 | |

**Table 4-45: Comparison of OFTEN and OFTEN2**

| | OFTEN | | | |
|---|---|---|---|---|
| OFTEN2 | About once or twice a year | About once or twice a month | About once a week | More than once a week |
| About once or twice a year | 19 | 16 | 5 | 1 |
| About once or twice a month | 24 | 293 | 61 | 15 |
| About once a week | 5 | 70 | 148 | 42 |
| More than once a week | 3 | 14 | 43 | 76 |

**Table 4-46: About how many seafood meals did you eat last month?**

DE

| Variable | Sample | Mean | StdDev | Minimum | Maximum |
|---|---|---|---|---|---|
| NUMBER5 | 101 | 5.65 | 7.39 | 0 | 60 |
| TYPICAL2 | 100 | 0.84 | 0.37 | 0 | 1 |
| TYPMONT2 | 17 | 2.76 | 2.44 | 0 | 9 |
| NUMBER6 | 98 | 5.86 | 7.38 | 0 | 60 |

MD/DC

| Variable | Sample | Mean | StdDev | Minimum | Maximum |
|---|---|---|---|---|---|
| NUMBER5 | 108 | 5.12 | 4.55 | 0 | 20 |
| TYPICAL2 | 108 | 0.82 | 0.38 | 0 | 1 |
| TYPMONT2 | 19 | 3.21 | 2.46 | 0 | 10 |
| NUMBER6 | 106 | 5.02 | 4.41 | 0 | 20 |

NC

| Variable | Sample | Mean | StdDev | Minimum | Maximum |
|---|---|---|---|---|---|
| NUMBER5 | 533 | 3.54 | 3.13 | 0 | 30 |
| TYPICAL2 | 524 | 0.83 | 0.37 | 0 | 1 |
| TYPMONT2 | 97 | 2.25 | 1.70 | 0 | 8 |
| NUMBER6 | 522 | 3.55 | 3.20 | 0 | 30 |

VA

| Variable | Sample | Mean | StdDev | Minimum | Maximum |
|---|---|---|---|---|---|
| NUMBER5 | 93 | 5.24 | 5.03 | 0 | 30 |
| TYPICAL2 | 93 | 0.81 | 0.40 | 0 | 1 |
| TYPMONT2 | 18 | 3.22 | 2.60 | 0 | 8 |
| NUMBER6 | 90 | 5.30 | 5.06 | 0 | 30 |

**Table 4-47: Did you find the information we sent you … ?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| UNDRPFST | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very helpful | 44 | 43.56 | 39 | 36.45 | 262 | 49.90 | 42 | 45.65 |
| Somewhat helpful | 54 | 53.47 | 61 | 57.01 | 235 | 44.76 | 47 | 51.09 |
| Not very helpful | 2 | 1.98 | 6 | 5.61 | 18 | 3.43 | 2 | 2.17 |
| Not helpful at all | 1 | 0.99 | 1 | 0.93 | 10 | 1.90 | 1 | 1.09 |
| Total | 101 | | 107 | | 525 | | 92 | |

**Table 4-48: Have you heard or read anything else about Pfiesteria since the first survey?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| NEWS1 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Yes | 39 | 38.61 | 21 | 19.63 | 162 | 30.92 | 18 | 19.35 |
| No | 62 | 61.39 | 86 | 80.37 | 362 | 69.08 | 75 | 80.65 |
| Total | 101 | | 107 | | 524 | | 93 | |

**Table 4-49: Did you read it in the newspapers, hear about it on television or something else?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| NEWS2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Newspaper | 29 | 76.32 | 12 | 57.14 | 70 | 43.21 | 10 | 55.56 |
| Television | 7 | 18.42 | 8 | 38.10 | 76 | 46.91 | 4 | 22.22 |
| Something else | 2 | 5.26 | 1 | 4.76 | 16 | 9.88 | 4 | 22.22 |
| Total | 38 | | 21 | | 162 | | 18 | |

**Table 4-50: Would you say that Pfiesteria is a … ?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| PFIEST2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Form of pollution | 13 | 13.98 | 13 | 13.00 | 92 | 20.09 | 9 | 10.34 |
| Disease in fish | 7 | 7.53 | 9 | 9.00 | 44 | 9.61 | 16 | 18.39 |
| Toxic organism | 58 | 62.37 | 52 | 52.00 | 253 | 55.24 | 46 | 52.87 |
| Predator that attacks fish | 2 | 2.15 | 1 | 1.00 | 13 | 2.84 | 2 | 2.30 |
| Parasite in fish | 13 | 13.98 | 25 | 25.00 | 56 | 12.23 | 14 | 16.09 |
| Total | 93 | | 100 | | 458 | | 87 | |

**Table 4-51: Have outbreaks of Pfiesteria occurred in [state] during the past month?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| OUTBREA2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Yes | 16 | 17.39 | 13 | 13.54 | 164 | 36.28 | 7 | 8.97 |
| No | 76 | 82.61 | 83 | 86.46 | 288 | 63.72 | 71 | 91.03 |
| Total | 92 | | 96 | | 452 | | 78 | |

**Table 4-52: How concerned are you about Pfiesteria?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| CONCERN2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very concerned | 39 | 38.61 | 37 | 34.26 | 190 | 35.85 | 29 | 31.18 |
| Somewhat concerned | 45 | 44.55 | 50 | 46.30 | 265 | 50.00 | 43 | 46.24 |
| Not concerned | 17 | 16.83 | 21 | 19.44 | 75 | 14.15 | 21 | 22.58 |
| Total | 101 | | 108 | | 530 | | 93 | |

**Table 4-53: Have you ever avoided eating seafood because of Pfiesteria outbreaks?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| AVOID2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Yes | 18 | 17.82 | 32 | 29.63 | 123 | 23.25 | 19 | 20.43 |
| No | 83 | 82.18 | 76 | 70.37 | 406 | 76.75 | 63 | 67.74 |
| Total | 101 | | 108 | | 529 | | 93 | |

**Table 4-54: Would a Pfiesteria outbreak in [state] next week reduce the number of seafood meals that you would eat next month?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| REDUCE2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Yes | 49 | 49.49 | 51 | 49.04 | 288 | 55.28 | 46 | 51.69 |
| No | 50 | 50.51 | 52 | 50.00 | 233 | 44.72 | 43 | 48.31 |
| Total | 99 | | 104 | | 521 | | 89 | |

**Table 4-55: It is safe to swim in coastal waters during a Pfiesteria outbreak.**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| SWIM2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Strongly agree | 3 | 2.97 | 2 | 1.87 | 19 | 3.59 | 1 | 1.08 |
| Agree | 18 | 17.82 | 13 | 12.15 | 87 | 16.45 | 22 | 23.66 |
| Disagree | 52 | 51.49 | 57 | 53.27 | 292 | 55.20 | 47 | 50.54 |
| Strongly disagree | 23 | 22.77 | 28 | 26.17 | 106 | 20.04 | 19 | 20.43 |
| Uncertain | 5 | 4.95 | 7 | 6.54 | 25 | 4.73 | 4 | 4.30 |
| Total | 101 | | 107 | | 529 | | 93 | |

**Table 4-56: It is safe to breathe the air around coastal waters during a Pfiesteria outbreak**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| BREATHE2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Strongly agree | 8 | 7.92 | 7 | 6.48 | 32 | 6.03 | 6 | 6.45 |
| Agree | 54 | 53.47 | 68 | 62.96 | 276 | 51.98 | 58 | 62.37 |
| Disagree | 23 | 22.77 | 22 | 20.37 | 135 | 25.42 | 18 | 19.35 |
| Strongly disagree | 4 | 3.96 | 3 | 2.78 | 15 | 2.82 | 1 | 1.08 |
| Uncertain | 12 | 11.88 | 8 | 7.41 | 73 | 13.75 | 10 | 10.75 |
| Total | 101 | | 108 | | 531 | | 93 | |

**Table 4-57: It is safe to eat seafood from an area where a Pfiesteria outbreak has happened.**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| EAT2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Strongly agree | 0 | 0.00 | 1 | 0.93 | 6 | 1.13 | 1 | 1.08 |
| Agree | 14 | 13.86 | 17 | 15.74 | 55 | 10.34 | 10 | 10.75 |
| Disagree | 52 | 51.49 | 51 | 47.22 | 317 | 59.59 | 53 | 56.99 |
| Strongly disagree | 29 | 28.71 | 37 | 34.26 | 128 | 24.06 | 22 | 23.66 |
| Uncertain | 6 | 5.94 | 2 | 1.85 | 26 | 4.89 | 7 | 7.53 |
| Total | 101 | | 108 | | 532 | | 93 | |

**Table 4-58: Pollution from farms can cause Pfiesteria outbreaks.**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| FARMS2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Strongly agree | 8 | 8.00 | 13 | 12.04 | 43 | 8.10 | 9 | 9.78 |
| Agree | 59 | 59.00 | 66 | 61.11 | 284 | 53.48 | 50 | 54.35 |
| Disagree | 18 | 18.00 | 15 | 13.89 | 86 | 16.20 | 13 | 14.13 |
| Strongly disagree | 1 | 1.00 | 1 | 0.93 | 8 | 1.51 | 0 | 0.00 |
| Uncertain | 14 | 14.00 | 13 | 12.04 | 110 | 20.72 | 20 | 21.74 |
| Total | 100 | | 108 | | 531 | | 92 | |

**Table 4-59: Pollution from factories can cause Pfiesteria outbreaks.**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| FACTORY2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Strongly agree | 8 | 8.00 | 12 | 11.11 | 41 | 7.74 | 3 | 3.26 |
| Agree | 59 | 59.00 | 57 | 52.78 | 297 | 56.04 | 55 | 59.78 |
| Disagree | 20 | 20.00 | 23 | 21.30 | 75 | 14.15 | 16 | 17.39 |
| Strongly disagree | 0 | 0.00 | 3 | 2.78 | 10 | 1.89 | 1 | 1.09 |
| Uncertain | 13 | 13.00 | 13 | 12.04 | 107 | 20.19 | 17 | 18.48 |
| Total | 100 | | 108 | | 530 | | 92 | |

**Table 4-60: Do you think the hypothetical fish kill is … ?**

| | MD Minor | | MD Major | | NC Minor | | NC Major | |
|---|---|---|---|---|---|---|---|---|
| BROC | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very realistic | 64 | 46.04 | 59 | 40.97 | 117 | 48.35 | 109 | 41.13 |
| Somewhat realistic | 66 | 47.48 | 67 | 46.53 | 110 | 45.45 | 133 | 50.19 |
| Not very realistic | 6 | 4.32 | 16 | 11.11 | 12 | 4.96 | 18 | 6.79 |
| Or not realistic at all | 3 | 2.16 | 2 | 1.39 | 3 | 1.24 | 5 | 1.89 |
| Total | 139 | | 144 | | 242 | | 265 | |

**Table 4-61: Do you think this is a major or minor fish kill?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| FISHKILL | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Major | 75 | 79.79 | 78 | 75.73 | 392 | 78.71 | 72 | 84.71 |
| Minor | 19 | 20.21 | 25 | 24.27 | 106 | 21.29 | 13 | 15.29 |
| Total | 94 | | 103 | | 498 | | 85 | |

**Table 4-62: Do you think this is a major or minor fish kill?**

| | MINOR | | MAJOR | |
|---|---|---|---|---|
| FISHKILL | Freq | Percent | Freq | Percent |
| Major | 276 | 73.80 | 341 | 83.99 |
| Minor | 98 | 26.20 | 65 | 16.01 |
| Total | 374 | | 406 | |

**Table 4-63: Source of Seafood Meals**

| Variable | N | Mean | Std Dev | Min | Max |
|---|---|---|---|---|---|
| POKOMOKE | 215 | 0.08 | 0.27 | 0 | 1 |
| MARYLAN | 261 | 0.84 | 0.37 | 0 | 1 |
| NEUSE | 409 | 0.10 | 0.30 | 0 | 1 |
| NORTHCA | 479 | 0.91 | 0.29 | 0 | 1 |

**Table 4-64: Would this make you think that seafood from the Pokomoke/Neuse River was not safe to eat?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Yes | 81 | 83.51 | 86 | 85.15 | 419 | 83.47 | 79 | 90.80 |
| No | 16 | 16.49 | 15 | 14.85 | 83 | 16.53 | 8 | 9.20 |
| Total | 97 | | 101 | | 502 | | 87 | |

**Table 4-65: What do you think are your chances of getting sick from eating these (NUMBER6) meals?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| CHANCE2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very likely | 12 | 12.00 | 12 | 11.54 | 53 | 10.33 | 11 | 12.09 |
| Somewhat likely | 35 | 35.00 | 27 | 25.96 | 186 | 36.26 | 30 | 32.97 |
| Somewhat not likely | 20 | 20.00 | 24 | 23.08 | 84 | 16.37 | 20 | 21.98 |
| Not likely at all | 33 | 33.00 | 41 | 39.42 | 190 | 37.04 | 30 | 32.97 |
| Total | 100 | | 104 | | 513 | | 91 | |

**Table 4-66: Do you think your chances are greater or less than 1%?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| PERCENT2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Greater | 31 | 30.69 | 29 | 26.85 | 138 | 27.27 | 25 | 26.88 |
| Less | 43 | 42.57 | 53 | 49.07 | 219 | 43.28 | 41 | 44.09 |
| About 1% | 26 | 25.74 | 24 | 22.22 | 149 | 29.45 | 19 | 20.43 |
| Total | 101 | | 108 | | 506 | | 93 | |

**Table 4-67: Do you think your chances are greater or less than RISK2?**

| | RISK2 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.000001 | | 0.00001 | | 0.0001 | | 0.001 | |
| CHANCE_B | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Greater | 24 | 25.26 | 11 | 13.25 | 9 | 10.34 | 12 | 13.19 |
| Less | 47 | 49.47 | 61 | 73.49 | 58 | 66.67 | 58 | 63.74 |
| About RISK2 | 15 | 15.79 | 5 | 6.02 | 17 | 19.54 | 14 | 15.38 |
| Total | 95 | | 83 | | 87 | | 91 | |

**Table 4-68: Number of Meals After the Hypothetical Fish Kill**

| NUMBER7 | N | Mean | Std Dev | Min | Max |
|---|---|---|---|---|---|
| DE | 99 | 4.21 | 6.88 | 0 | 60 |
| MD/DC | 106 | 4.32 | 4.44 | 0 | 20 |
| NC | 507 | 2.74 | 3.16 | 0 | 30 |
| VA | 87 | 4.36 | 5.25 | 0 | 30 |
| MINOR=0 | 391 | 3.28 | 3.66 | 0 | 26 |
| MAJOR=1 | 408 | 3.34 | 4.80 | 0 | 60 |
| FISHKILL=0 | 157 | 4.39 | 6.06 | 0 | 60 |
| FISHKILL=1 | 592 | 2.96 | 3.60 | 0 | 30 |

**Table 4-69: What else would you change (about your eating habits)? I would …**

| CHANGE | Frequency | Percent |
|---|---|---|
| Eat more restaurant meals | 2 | 1.56 |
| Eat fewer restaurant meals | 11 | 8.59 |
| Go fishing more | 2 | 1.56 |
| Go fishing less | 7 | 5.47 |
| Cook at home more | 9 | 7.03 |
| Cook at home less | 3 | 2.34 |
| Eat more poultry | 26 | 20.31 |
| Eat more meat | 19 | 14.84 |
| Eat more vegetables | 17 | 13.28 |
| Eat more beans | 3 | 2.34 |
| Eat more eggs | 2 | 1.56 |
| Eat more canned seafood | 6 | 4.69 |
| Not eat croaker | 4 | 3.13 |
| Not eat flounder | 3 | 2.34 |
| Other | 68 | 53.13 |

**Table 4-70: Do you think the information that we sent you is … ?**

| | DE | | MD/DC | | NC | | Va | |
|---|---|---|---|---|---|---|---|---|
| INSPECT | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very clear | 60 | 64.52 | 51 | 54.84 | 257 | 52.99 | 50 | 59.52 |
| Somewhat clear | 30 | 32.26 | 39 | 41.94 | 209 | 43.09 | 31 | 36.90 |
| Not very clear | 3 | 3.23 | 3 | 3.23 | 13 | 2.68 | 2 | 2.38 |
| Or not clear at all | 0 | 0.00 | 0 | 0.00 | 6 | 1.24 | 1 | 1.19 |
| Total | 93 | | 93 | | 485 | | 84 | |

**Table 4-71: What do you think are your changes of getting sick from eating these (NUMBER8) meals?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| CHANCE2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very likely | 5 | 5.00 | 3 | 2.80 | 22 | 4.22 | 3 | 3.26 |
| Somewhat likely | 14 | 14.00 | 15 | 14.02 | 78 | 14.97 | 14 | 15.22 |
| Somewhat not likely | 21 | 21.00 | 25 | 23.36 | 119 | 22.84 | 24 | 26.09 |
| Not likely at all | 60 | 60.00 | 64 | 59.81 | 302 | 57.97 | 51 | 55.43 |
| Total | 100 | | 107 | | 521 | | 92 | |

**Table 4-72: Do you think your chances are greater or less than 1%**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| PERCENT2 | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Greater | 13 | 12.87 | 11 | 10.19 | 48 | 9.04 | 7 | 7.53 |
| Less | 68 | 67.33 | 77 | 71.30 | 345 | 64.97 | 66 | 70.97 |
| About 1% | 19 | 18.81 | 19 | 17.59 | 127 | 23.92 | 18 | 19.35 |
| Total | 1 | 0.99 | 1 | 0.93 | 11 | 2.07 | 2 | 2.15 |
| | 101 | | 108 | | 531 | | 93 | |

**Table 4-73: Do you think your chances are greater or less than RISK3?**

| | RISK3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.000001 | | 0.00001 | | 0.0001 | | 0.001 | |
| CHANCE_C | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Greater | 27 | 23.68 | 13 | 8.97 | 14 | 11.02 | 6 | 4.11 |
| Less | 68 | 59.65 | 108 | 74.48 | 99 | 77.95 | 116 | 79.45 |
| About RISK2 | 19 | 16.67 | 24 | 16.55 | 14 | 11.02 | 24 | 16.44 |
| Total | 114 | | 145 | | 127 | | 146 | |

**Table 4-74: Number of Meals After the Hypothetical Fish Kill and with the Seafood Inspection Program**

| | NUMBER8 | | | | |
|---|---|---|---|---|---|
| | N | Mean | Std Dev | Min | Max |
| DE | 99 | 5.01 | 7.81 | 0 | 60 |
| MD/DC | 106 | 4.25 | 4.28 | 0 | 20 |
| NC | 519 | 2.72 | 2.98 | 0 | 30 |
| VA | 91 | 4.01 | 4.57 | 0 | 30 |

| | NUMBER9 | | | | |
|---|---|---|---|---|---|
| | N | Mean | Std Dev | Min | Max |
| DE | 101 | 5.24 | 6.93 | 0 | 60 |
| MD/DC | 105 | 5.22 | 4.39 | 0 | 20 |
| NC | 521 | 3.45 | 3.23 | 0 | 30 |
| VA | 91 | 5.18 | 5.28 | 0 | 30 |

**Table 4-75: NUMBER9 by Price Increase (DP9)**

| | NUMBER9 | | | | |
|---|---|---|---|---|---|
| DP9 | N | Mean | Std Dev | Min | Max |
| 1 | 212 | 3.36 | 3.45 | 0 | 32 |
| 3 | 202 | 4.14 | 6.22 | 0 | 60 |
| 5 | 201 | 3.03 | 3.56 | 0 | 26 |
| 7 | 200 | 2.84 | 3.13 | 0 | 18 |

**Table 4-76: Would you vote for or against it (the seafood inspection program)?**

| | DE | | MD/DC | | NC | | Va | |
|---|---|---|---|---|---|---|---|---|
| ELEC | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| For | 78 | 79.59 | 68 | 70.10 | 383 | 75.25 | 67 | 78.82 |
| Against | 20 | 20.41 | 29 | 29.90 | 126 | 24.75 | 18 | 21.18 |
| Total | 98 | | 97 | | 509 | | 85 | |

**Table 4-77: Comparison of ELEC and DP9?**

| | For | | Against | |
|---|---|---|---|---|
| DP9 | Freq | Percent For | Freq | Percent Against |
| 1 | 175 | 85.37 | 30 | 14.63 |
| 3 | 151 | 79.06 | 40 | 20.94 |
| 5 | 143 | 73.33 | 52 | 26.67 |
| 7 | 127 | 64.14 | 71 | 35.86 |
| Total | 596 | | 193 | |

**Table 4-78: Are you … you would vote for/against the proposal?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| SURE | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very sure | 71 | 72.45 | 61 | 63.54 | 357 | 70.69 | 57 | 67.06 |
| Somewhat sure | 20 | 20.41 | 23 | 23.96 | 119 | 23.56 | 19 | 22.35 |
| Somewhat not sure | 5 | 5.10 | 8 | 8.33 | 21 | 4.16 | 5 | 5.88 |
| Not sure at all | 2 | 2.04 | 4 | 4.17 | 8 | 1.58 | 4 | 4.71 |
| Total | 98 | | 96 | | 505 | | 85 | |

**Table 4-79: Comparison of ELEC and SURE**

| | Very Sure | | Somewhat Sure | | Somewhat Not Sure | | Not Sure at All | |
|---|---|---|---|---|---|---|---|---|
| INSPECT | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| For | 445 | 81.50 | 122 | 67.40 | 18 | 46.15 | 7 | 38.89 |
| Against | 101 | 18.50 | 59 | 32.60 | 21 | 53.85 | 11 | 61.11 |
| Total | 546 | | 181 | | 39 | | 18 | |

**Table 4-80: How likely is it that you will vote in the November national election. Are you …?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| VOTE | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very sure | 71 | 86.59 | 77 | 83.70 | 371 | 84.51 | 67 | 84.81 |
| Somewhat sure | 6 | 7.32 | 8 | 8.70 | 25 | 5.69 | 2 | 2.53 |
| Somewhat not sure | 1 | 1.22 | 4 | 4.35 | 21 | 4.78 | 4 | 5.06 |
| Not sure at all | 4 | 4.88 | 3 | 3.26 | 22 | 5.01 | 6 | 7.59 |
| Total | 82 | | 92 | | 439 | | 79 | |

**Table 4-81: A Comparison of VOTE and ELEC**

| | VOTE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Very Sure | | Somewhat Sure | | Somewhat Not Sure | | Not Sure at All | |
| ELEC | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| For | 442 | 80.36 | 33 | 86.84 | 18 | 66.67 | 20 | 58.82 |
| Against | 128 | 23.27 | 5 | 13.16 | 9 | 33.33 | 14 | 41.18 |
| Total | 550 | | 38 | | 27 | | 34 | |

**Table 4-82: Did you understand these questions … ?**

| | DE | | MD/DC | | NC | | Va | |
|---|---|---|---|---|---|---|---|---|
| UNDERST | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very well | 80 | 79.21 | 81 | 75.70 | 385 | 72.50 | 67 | 72.83 |
| Somewhat well | 19 | 18.81 | 25 | 23.36 | 141 | 26.55 | 24 | 26.09 |
| Not very well | 2 | 1.98 | 1 | 0.93 | 5 | 0.94 | 9 | 9.78 |
| Not at all | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Total | 101 | | 107 | | 531 | | 92 | |

**Table 4-83: Were these questions … to answer?**

| | DE | | MD/DC | | NC | | Va | |
|---|---|---|---|---|---|---|---|---|
| HARD | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very hard | 1 | 0.99 | 2 | 1.89 | 14 | 2.65 | 2 | 2.15 |
| Somewhat hard | 15 | 14.85 | 12 | 11.32 | 79 | 14.96 | 15 | 16.13 |
| Somewhat easy | 41 | 40.59 | 48 | 45.28 | 214 | 40.53 | 36 | 38.71 |
| Very easy | 44 | 43.56 | 44 | 41.51 | 221 | 41.86 | 40 | 43.01 |
| Total | 101 | | 106 | | 528 | | 93 | |

**Table 4-84: How sure were you about your answers? Were you … ?**

| | DE | | MD/DC | | NC | | VA | |
|---|---|---|---|---|---|---|---|---|
| CERTAIN | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Very sure | 67 | 66.34 | 56 | 52.34 | 288 | 54.24 | 44 | 47.31 |
| Somewhat sure | 33 | 32.67 | 47 | 43.93 | 230 | 43.31 | 46 | 49.46 |
| Somewhat not sure | 1 | 0.99 | 3 | 2.80 | 10 | 1.88 | 3 | 3.23 |
| Not sure at all | 0 | 0.00 | 1 | 0.93 | 3 | 0.56 | 0 | 0.00 |
| Total | 101 | | 107 | | 531 | | 93 | |

**Table 4-85: Would you like a summary of the results of this survey?**

| | Very Sure | | Somewhat Sure | | Somewhat Not Sure | | Not Sure at All | |
|---|---|---|---|---|---|---|---|---|
| SUMMARY | Freq | Percent | Freq | Percent | Freq | Percent | Freq | Percent |
| Yes | 78 | 77.23 | 81 | 75.00 | 386 | 71.61 | 72 | 77.42 |
| No | 23 | 22.77 | 27 | 25.00 | 145 | 26.90 | 21 | 22.58 |
| Total | 101 | | 108 | | 531 | | 93 | |

**Chapter 5. Tables**

**Table 5-1: Data Description**

| Variable | Description | Mean | Std.Dev. | Min | Max |
|---|---|---|---|---|---|
| STATE | Tenure in state | 30.91 | 20.82 | 0 | 82 |
| HOUSE | Household size | 2.68 | 1.34 | 0 | 7 |
| CHILDREN | Number of children | 0.70 | 1.05 | 0 | 5 |
| EDUC | Years of schooling | 14.50 | 2.53 | 3 | 20 |
| AGE | Age in years | 46.86 | 15.66 | 18 | 100 |
| MALE | Gender: Male=1, 0 otherwise | 0.36 | 0.48 | 0 | 1 |
| WHITE | Race: White=1, 0 otherwise | 0.77 | 0.42 | 0 | 1 |
| URBAN | Urban county = 1, 0 otherwise | 0.33 | 0.47 | 0 | 1 |
| INCOME | Household income (in thousands) | 52.70 | 25.87 | 5 | 100 |
| DE | Delaware resident = 1, 0 otherwise | 0.12 | 0.33 | 0 | 1 |
| MD | Maryland/DC resident =1, 0 otherwise | 0.13 | 0.34 | 0 | 1 |
| VA | Virginia resident = 1, 0 otherwise | 0.11 | 0.32 | 0 | 1 |
| Sample Size | | 833 | | | |

**Table 5-2: Cultural Models Compared with Behavioral Responses**

| | AVOID | | REDUCE | |
|---|---|---|---|---|
| (PFIEST) What is Pfiesteria? | First | Second | First | Second |
| Pollution | 30% | 20% | 30% | 20% |
| Toxic Organism | 32% | 58% | 30% | 53% |
| Disease or Parasite | 37% | 21% | 40% | 26% |
| Sample Size | 466 | 470 | 444 | 446 |
| $\chi^2$[2 df] | 2.71 | 3.59 | 9.84 | 14.46 |

**Table 5-3: Cultural Models Compared with Concern about Pfiesteria**

| | CONCERN | |
|---|---|---|
| (PFIEST) What is Pfiesteria? | First | Second |
| Pollution | 32% | 21% |
| Toxic Organism | 34% | 61% |
| Disease or Parasite | 34% | 18% |
| Sample Size | 468 | 472 |
| $\chi^2$[2 df] | 7.92 | 8.10 |

**Table 5-4: Random Effects Probit Modesl**

| | PFIEST | | OUTBREAK | | AVOID | | REDUCE | |
|---|---|---|---|---|---|---|---|---|
| Variable | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio |
| Constant | -3.547 | -6.09 | 0.07 | 0.10 | 0.030 | 0.04 | 3.022 | 4.85 |
| PFIEBROC | 1.044 | 6.26 | -0.29 | -1.69 | -0.202 | -1.16 | -0.084 | -0.57 |
| COUNTER | -0.118 | -0.59 | 0.23 | 1.00 | -0.159 | -0.70 | -0.352 | -1.84 |
| STATE | -0.004 | -0.98 | 0.00 | -0.25 | 0.015 | 2.39 | -0.012 | -0.04 |
| HOUSE | -0.111 | -1.18 | -0.16 | -1.22 | 0.157 | 1.37 | 0.018 | 0.09 |
| CHILDREN | 0.186 | 1.70 | 0.20 | 1.35 | -0.311 | -2.14 | -0.209 | -1.06 |
| EDUC | 0.140 | 4.38 | -0.04 | -0.88 | -0.017 | -0.43 | 0.000 | 0.02 |
| AGE | 0.010 | 1.64 | 0.01 | 1.50 | -0.006 | -0.75 | 0.249 | 2.85 |
| MALE | -0.009 | -0.06 | -0.59 | -3.38 | -0.791 | -3.91 | -0.210 | -1.97 |
| WHITE | 0.691 | 4.14 | -0.37 | -1.98 | -1.130 | -5.07 | -0.146 | -4.47 |
| URBAN | 0.407 | 2.46 | -0.15 | -0.67 | -0.833 | -3.56 | 0.008 | 1.25 |
| INCOME | 0.002 | 0.84 | 0.01 | 1.64 | -0.001 | -0.23 | -0.724 | -4.73 |
| DE | 0.405 | 1.21 | -0.17 | -0.55 | 0.336 | 0.83 | -1.352 | -6.84 |
| MD | -0.369 | -1.78 | -0.91 | -3.49 | 0.921 | 3.36 | -0.518 | -3.01 |
| VA | 0.251 | 1.36 | -1.36 | -5.63 | 0.234 | 0.97 | 0.002 | 0.58 |
| $\sigma$ | 0.454 | 6.55 | 0.38 | 3.71 | 0.690 | 14.74 | 0.592 | 11.32 |
| Log-L(B) | -570.61 | | -383.22 | | -640.67 | | -714.59 | |
| Log-L(0) | -671.26 | | -548.18 | | -743.59 | | -843.86 | |
| Sample Size | 485 | | 468 | | 641 | | 614 | |
| Periods | 2 | | 2 | | 2 | | 2 | |

**Table 5-5: Random Effects Ordered Probit Models**

| | Pooled CONCERN | | North Carolina CONCERN | | DE-MD-VA CONCERN | |
|---|---|---|---|---|---|---|
| Variable | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio |
| Constant | 2.160 | 4.00 | 1.266 | 2.11 | 2.337 | 2.71 |
| PFIEBROC | 0.126 | 1.02 | 0.228 | 1.73 | 0.099 | 0.46 |
| COUNTER | -0.269 | -1.66 | -0.406 | -2.11 | -0.215 | -0.80 |
| STATE | 0.014 | 3.50 | 0.006 | 1.49 | 0.017 | 2.47 |
| HOUSE | -0.036 | -0.44 | 0.034 | 0.28 | -0.015 | -0.12 |
| CHILDREN | 0.168 | 1.72 | -0.120 | -0.79 | 0.213 | 1.39 |
| EDUC | -0.060 | -2.22 | 0.039 | 1.15 | -0.094 | -2.17 |
| AGE | 0.012 | 2.07 | 0.014 | 2.23 | 0.010 | 1.09 |
| MALE | -0.023 | -0.18 | -0.138 | -0.84 | 0.004 | 0.02 |
| WHITE | -0.914 | -5.96 | -0.819 | -3.82 | -0.953 | -3.85 |
| URBAN | -0.157 | -1.02 | -0.400 | -2.07 | -0.113 | -0.51 |
| INCOME | -0.001 | -0.22 | -0.003 | -0.82 | 0.000 | -0.12 |
| DE | 0.063 | 0.24 | | | | |
| MD | -0.174 | -0.95 | | | | |
| VA | -0.198 | -1.13 | | | | |
| $\mu_1$ | 1.743 | 22.99 | 2.165 | 16.81 | 1.634 | 14.22 |
| $\sigma$ | 1.181 | 14.12 | 1.185 | 10.33 | 1.165 | 8.82 |
| Log-L(B) | -1226.81 | | -706.85 | | -481.77 | |
| Log-L(0) | -1325.69 | | -778.48 | | -538.83 | |
| Sample Size | 647 | | 394 | | 253 | |
| Periods | 2 | | 2 | | 2 | |

[a]Dependent variable = 2 (very concerned), 1 (somewhat concerned), and 0 (not concerned)

**Table 5-6: Ordered Probit Models**

| | CONCERN | | HANDLING | | FRESH | | DISEASE | |
|---|---|---|---|---|---|---|---|---|
| Variable | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio |
| Constant | 1.751 | 8.40 | -0.792 | -3.74 | -0.702 | -3.05 | -1.976 | -10.36 |
| STATE | 0.010 | 7.40 | -0.004 | -3.41 | -0.005 | -3.98 | -0.006 | -4.17 |
| HOUSE | -0.062 | -2.38 | -0.033 | -1.19 | -0.087 | -3.23 | -0.029 | -1.21 |
| CHILDREN | 0.105 | 3.39 | 0.028 | 0.95 | 0.038 | 1.15 | -0.016 | -0.57 |
| EDUC | -0.051 | -6.60 | 0.045 | 5.14 | 0.012 | 1.36 | 0.115 | 13.28 |
| AGE | 0.005 | 2.92 | -0.002 | -1.14 | 0.002 | 1.31 | 0.002 | 1.26 |
| MALE | 0.017 | 0.44 | -0.011 | -0.30 | 0.174 | 4.35 | 0.097 | 2.65 |
| WHITE | -0.724 | -17.56 | 0.626 | 16.39 | 0.389 | 9.73 | 0.460 | 11.26 |
| URBAN | -0.067 | -1.19 | 0.054 | 1.00 | -0.056 | -1.06 | 0.284 | 5.48 |
| INCOME | 0.001 | 0.91 | 0.001 | 1.34 | 0.002 | 3.46 | -0.003 | -4.10 |
| DE | 0.018 | 0.05 | -0.003 | -0.01 | 0.170 | 0.42 | -0.076 | -0.19 |
| MD | -0.135 | -1.00 | 0.171 | 1.34 | 0.231 | 1.61 | -0.012 | -0.11 |
| VA | -0.021 | -0.16 | 0.050 | 0.39 | -0.008 | -0.06 | 0.369 | 3.26 |
| $\mu_1$ | 1.029 | 18.13 | 1.074 | 18.00 | 1.035 | 15.66 | 0.945 | 16.03 |
| Log-L(B) | -644.42 | | -650.05 | | -581.11 | | -625.10 | |
| Log-L(0) | -669.86 | | -663.31 | | -583.60 | | -629.92 | |
| Sample Size | 647 | | 634 | | 645 | | 637 | |

[a]Dependent variable = 2 (very concerned), 1 (somewhat concerned), and 0 (not concerned)

**Table 5-7: Random Effects Ordered Probit Models: Attitudes**

| | SWIM[a] | | BREATHE[b] | | EAT[a] | | FARMS[b] | | FACTORY[b] | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio |
| Constant | 0.972 | 3.00 | 0.312 | 0.80 | -0.548 | -1.81 | 1.636 | 4.29 | 1.818 | 4.36 |
| PFIEBROC | 0.047 | 0.50 | 0.099 | 1.07 | 0.113 | 1.25 | 0.241 | 2.65 | 0.219 | 2.19 |
| COUNTER | 0.272 | 2.25 | 0.047 | 0.34 | 0.243 | 2.04 | -0.356 | -2.73 | -0.421 | -3.01 |
| STATE | -0.006 | -2.11 | -0.003 | -1.10 | 0.003 | 1.15 | 0.007 | 2.73 | 0.011 | 3.20 |
| HOUSE | 0.029 | 0.57 | 0.083 | 1.52 | 0.023 | 0.48 | -0.172 | -2.70 | -0.022 | -0.33 |
| CHILDREN | -0.066 | -1.06 | -0.038 | -0.54 | -0.035 | -0.62 | 0.193 | 2.41 | 0.110 | 1.35 |
| EDUC | -0.027 | -1.44 | 0.026 | 1.19 | 0.018 | 1.00 | 0.021 | 1.09 | -0.009 | -0.43 |
| AGE | 0.004 | 0.95 | -0.009 | -2.11 | 0.004 | 1.42 | -0.012 | -2.83 | -0.004 | -0.78 |
| MALE | 0.235 | 2.86 | 0.308 | 3.22 | 0.048 | 0.61 | -0.124 | -1.26 | -0.238 | -2.16 |
| WHITE | 0.011 | 0.11 | 0.755 | 6.48 | 0.153 | 1.70 | 0.098 | 0.81 | -0.313 | -2.58 |
| URBAN | 0.096 | 0.96 | 0.216 | 1.99 | 0.160 | 1.67 | -0.085 | -0.75 | -0.303 | -2.43 |
| INCOME | 0.001 | 0.76 | -0.006 | -3.09 | 0.002 | 1.21 | 0.000 | -0.02 | -0.002 | -0.82 |
| DE | -0.164 | -0.94 | 0.018 | 0.09 | 0.058 | 0.36 | 0.193 | 0.98 | 0.086 | 0.37 |
| MD | -0.234 | -1.94 | 0.178 | 1.36 | -0.092 | -0.83 | 0.172 | 1.27 | 0.114 | 0.74 |
| VA | -0.056 | -0.52 | 0.235 | 1.97 | -0.036 | -0.35 | 0.128 | 1.03 | -0.331 | -2.26 |
| $\mu_1$ | 1.645 | 24.52 | 0.491 | 14.14 | 1.523 | 24.25 | 0.885 | 18.12 | 0.910 | 18.24 |
| $\mu_2$ | 1.905 | 26.17 | 2.873 | 27.61 | 1.759 | 25.18 | 2.978 | 30.37 | 3.142 | 30.19 |
| $\sigma$ | 0.548 | 7.78 | 0.702 | 10.42 | 0.410 | 5.15 | 0.729 | 11.11 | 0.914 | 13.96 |
| Log-L(B) | -1459.39 | | -1341.95 | | -1422.40 | | -1449.64 | | -1468.38 | |
| Log-L(0) | -1490.99 | | -1462.91 | | -1516.83 | | -1516.83 | | -1523.91 | |
| Sample Size | 646 | | 642 | | 654 | | 646 | | 647 | |
| Periods | 2 | | 2 | | 2 | | 2 | | 2 | |

[a]Dependent variable = 3 (Strongly Agree or Agree), 2 (Uncertain), 1 (Disagree), 0 (Strongly Disagree)

[b]Dependent variable = 3 (Strongly Agree), 2 (Agree), 1 (Uncertain), 1 (Disagree or Strongly Disagree)

**Table 5-8: Random Effects Ordered Probit Models: Chance of Getting Sick**

| | Pooled | | NC | | DE-ME-VA | |
|---|---|---|---|---|---|---|
| | CHANCE[a] | | CHANCE[a] | | CHANCE[a] | |
| Variable | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio |
| Constant | 0.312 | 0.91 | 0.097 | 0.25 | 0.466 | 0.77 |
| MINOR | 1.409 | 14.87 | 1.412 | 11.30 | 1.439 | 9.18 |
| MAJOR | 1.412 | 13.87 | 1.411 | 10.60 | 1.422 | 8.42 |
| PFIEBROC | -0.861 | -12.04 | -0.783 | -9.46 | -0.893 | -7.09 |
| COUNTER | -0.032 | -0.35 | -0.229 | -1.85 | 0.011 | 0.07 |
| SIP | -0.035 | -0.41 | -0.124 | -1.23 | 0.055 | 0.38 |
| STATE | -0.002 | -0.69 | 0.000 | -0.11 | -0.002 | -0.48 |
| HOUSE | 0.217 | 4.23 | 0.028 | 0.44 | 0.272 | 3.03 |
| CHILDREN | -0.197 | -2.98 | -0.017 | -0.20 | -0.248 | -2.20 |
| EDUC | -0.013 | -0.70 | -0.007 | -0.36 | -0.013 | -0.42 |
| AGE | -0.005 | -1.20 | -0.002 | -0.40 | -0.007 | -1.00 |
| MALE | -0.179 | -2.05 | -0.243 | -2.47 | -0.160 | -1.01 |
| WHITE | -0.659 | -7.07 | -0.339 | -2.94 | -0.773 | -4.84 |
| URBAN | 0.022 | 0.23 | 0.008 | 0.08 | -0.070 | -0.45 |
| INCOME | -0.009 | -4.76 | -0.005 | -2.48 | -0.010 | -3.27 |
| DE | -0.014 | -0.08 | | | | |
| MD | -0.186 | -1.58 | | | | |
| VA | 0.061 | 0.58 | | | | |
| $\mu_1$ | 0.960 | 24.52 | 0.80 | 19.55 | 1.02 | 14.60 |
| $\mu_2$ | 2.334 | 32.53 | 2.11 | 28.15 | 2.43 | 18.35 |
| $\sigma$ | 0.804 | 15.08 | 0.70 | 11.32 | 0.83 | 8.99 |
| Log-L(B) | -2315.80 | | -1539.97 | | -829.03 | |
| Log-L(0) | -2685.36 | | -1707.32 | | -975.14 | |
| Sample Size | 790 | | 501 | | 289 | |
| Periods | 3 | | 3 | | 3 | |

[a]CHANCE= 3 (Very Likely), 2 (Somewhat Likely), 1 (Somewhat not likely), 0 (Not Likely)

## Chapter 6. Tables

**Table 6-1: Experimental Design**

| Sub Sample | Fish Kill Insert | Seafood Inspection | Brochure | Counter Information | Target Sample | Sample Location |
|---|---|---|---|---|---|---|
| 1 | Minor MD | Yes | Yes | Yes | 200 | MD/DE/VA/DC |
| 2 | Major MD | Yes | Yes | Yes | 200 | MD/DE/VA/DC |
| 3 | Minor MD | Yes | Yes | | 200 | MD/DE/VA/DC |
| 4 | Major MD | Yes | Yes | | 200 | MD/DE/VA/DC |
| 5 | Minor MD | Yes | | | 100 | MD/DE/VA/DC |
| 6 | Major MD | Yes | | | 100 | MD/DE/VA/DC |
| 7 | Minor NC | Yes | Yes | Yes | 200 | NC |
| 8 | Major NC | Yes | Yes | Yes | 200 | NC |
| 9 | Minor NC | Yes | Yes | | 200 | NC |
| 10 | Major NC | Yes | Yes | | 200 | NC |
| 11 | Minor NC | Yes | | | 100 | NC |
| 12 | Major NC | Yes | | | 100 | NC |

**Table 6-2: Quantitative Risk Responses**

| | | First Survey | | Second Survey (Before SIP) | | Second Survey (After SIP) | |
|---|---|---|---|---|---|---|---|
| | Offered Risk | % > | # Offered | % > | # Offered | % > | #Offered |
| 1st Response | 0.01 | 38% | 1729 | 55% | 808 | 31% | 808 |
| 2nd Response | 0.001 | 32% | 257 | 29% | 95 | 21% | 150 |
| | 0.0001 | 38% | 245 | 30% | 87 | 22% | 134 |
| | 0.00001 | 36% | 245 | 19% | 83 | 25% | 143 |
| | 0.000001 | 52% | 245 | 41% | 97 | 38% | 120 |

**Table 6-3: Baseline Random Effects Probit Model**

First Quantitative Risk Question Only
1729 Observations, 2744 Responses

| Variable | Coeff. | z-stat |
|---|---|---|
| *Controls* | | |
| Constant | -0.718 | -4.34 |
| MD =1 | -0.073 | -0.78 |
| DE =1 | -0.062 | -0.38 |
| VA =1 | -0.024 | -0.26 |
| DC =1 | -0.071 | -0.39 |
| *Distributional Variables* | | |
| Random Effect | 0.431 | 3.33 |
| 1/σ | 0.075 | 3.05 |
| | | |
| Log-Likelihood | -1816.189 | |
| Chi-Squared | 19.53308 | |
| | | |
| Predicted Mean Risk | 0.0000482 | |

**Table 6-4: Random Effects Probit Models**

1746 Observations, 5269 responses

| | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| Variable | Coeff. | z-stat | Coeff. | z-stat | Coeff. | z-stat |
| *Controls* | | | | | | |
| Constant | -0.436 | -5.98 | -0.357 | -1.52 | -0.606 | -2.61 |
| MD =1 | -0.145 | -1.92 | -0.151 | -2.00 | -0.150 | -2.08 |
| DE =1 | 0.011 | 0.08 | -0.024 | -0.18 | -0.023 | -0.18 |
| VA =1 | -0.101 | -1.31 | -0.115 | -1.46 | -0.109 | -1.45 |
| DC =1 | 0.185 | 1.17 | 0.121 | 0.78 | 0.137 | 0.91 |
| *Information Treatments* | | | | | | |
| Brochure? | 0.199 | 2.48 | 0.182 | 2.26 | 0.183 | 2.24 |
| Minor Fish Kill? | 0.016 | 0.21 | 0.020 | 0.26 | -0.116 | -1.31 |
| Major Fish Kill? | 0.185 | 2.36 | 0.191 | 2.43 | 0.028 | 0.31 |
| Realistic Scenario and Minor Fish Kill | | | | | 0.303 | 3.21 |
| Realistic Scenario and Major Fish Kill | | | | | 0.338 | 3.66 |
| Counter Information? | -0.078 | -0.99 | -0.058 | -0.74 | -0.051 | -0.65 |
| Seafood Inspection Program=1 | -0.647 | -9.58 | -0.647 | -9.54 | -0.626 | -9.08 |
| *Demographics* | | | | | | |
| Years in State | | | -0.004 | -2.38 | -0.004 | -2.36 |
| AGE | | | -0.002 | -0.94 | -0.002 | -0.82 |
| Years of Education | | | 0.002 | 0.16 | 0.003 | 0.22 |
| INCOME | | | -0.001 | -0.95 | -0.001 | -1.07 |
| MALE | | | 0.037 | 0.61 | 0.032 | 0.56 |
| WHITE=1 | | | -0.001 | -0.01 | -0.001 | -0.02 |
| # in Household | | | 0.105 | 2.96 | 0.108 | 3.18 |
| # Children in Household | | | -0.144 | -3.49 | -0.145 | -3.62 |
| *Distributional Variables* | | | | | | |
| Random Effect | 0.376 | 13.27 | 0.368 | 12.86 | 0.329 | 10.96 |
| $1/\sigma$ | 0.037 | 5.86 | 0.036 | 5.71 | 0.092 | 6.90 |
| Follow-Up Question=1 | | | | | -0.448 | -4.83 |
| | | | | | | |
| Log-Likelihood | -3210.022 | | -3197.836 | | -3177.374 | |
| Chi-Squared | 376.2962 | | 364.9427 | | 314.3247 | |

**Table 6-4: Random Effects Probit Models Continued**

| | Model 4 | | Model 5 | |
|---|---|---|---|---|
| Variable | Coeff. | z-stat | Coeff. | z-stat |
| *Controls* | | | | |
| Constant | -0.682 | -2.70 | -0.759 | -2.93 |
| MD =1 | -0.131 | -1.81 | -0.119 | -1.64 |
| DE =1 | -0.009 | -0.07 | -0.011 | -0.09 |
| VA =1 | -0.108 | -1.45 | -0.078 | -1.04 |
| DC =1 | 0.140 | 0.96 | 0.137 | 0.93 |
| *Information Treatments* | | | | |
| Brochure? | 0.171 | 2.10 | 0.026 | 0.20 |
| Brochure and heard of Pfiesteria (1st Survey) | | | 0.165 | 1.35 |
| Minor Fish Kill? | -0.090 | -1.02 | -0.121 | -1.33 |
| Major Fish Kill? | 0.040 | 0.45 | 0.017 | 0.19 |
| Realistic Scenario and Minor Fish Kill | 0.286 | 3.04 | 0.273 | 2.84 |
| Realistic Scenario and Major Fish Kill | 0.319 | 3.45 | 0.289 | 3.09 |
| Counter Information? | -0.052 | -0.67 | -0.050 | -0.63 |
| Seafood Inspection Program=1 | -0.627 | -9.12 | -0.631 | -9.13 |
| *Demographics* | | | | |
| Years in State | -0.003 | -1.94 | -0.003 | -1.94 |
| AGE | -0.002 | -1.17 | -0.003 | -1.29 |
| Years of Education | 0.003 | 0.27 | 0.005 | 0.45 |
| INCOME | -0.001 | -0.93 | -0.001 | -1.00 |
| MALE | 0.069 | 1.20 | 0.075 | 1.31 |
| WHITE=1 | 0.037 | 0.60 | 0.057 | 0.92 |
| # in Household | 0.108 | 3.24 | 0.108 | 3.20 |
| # Children in Household | -0.139 | -3.57 | -0.144 | -3.68 |
| *Seafood Safety Perceptions* | | | | |
| Seafood Most Likely to Make Sick | 0.296 | 4.39 | 0.299 | 4.43 |
| Seafood is Somewhat or Very Safe | -0.246 | -2.63 | -0.243 | -2.61 |
| Very or Somewhat Concerned with Seafood Handling Practice | 0.248 | 3.65 | 0.168 | 2.33 |
| *Pfiesteria Perceptions* | | | | |
| Heard of Pfiesteria (1st Survey) yes=1 | | | -0.180 | -2.07 |
| Very or Somewhat Concerned About Disease in Fish | | | 0.097 | 1.30 |
| Outbreak Occurred in the Last Month? | | | 0.086 | 1.40 |
| Very or Somewhat Concerned About Pfiesteria? | | | 0.234 | 3.55 |
| *Distributional Variables* | | | | |
| Random Effect | 0.319 | 10.63 | 0.314 | 10.44 |
| 1/ $\sigma$ | 0.091 | 6.86 | 0.092 | 6.85 |
| Follow-Up Question=1 | -0.438 | -4.74 | -0.439 | -4.73 |
| Log-Likelihood | -3155.042 | | -3144.987 | |
| Chi-Squared | 305.3873 | | 300.0476 | |

# Chapter 7. Tables

**Table 7-1: Five Contingent Behavior Questions**

| Question Number | Wording |
|---|---|
| Question 1: Price up | Seafood prices change over time. For example, if a lot of fish are caught, prices go down. When fewer fish are caught, prices go up. Suppose the price of your portion of your average seafood meal goes up by $X but the price of all other foods stays the same. Compared to the [NUMBER] meals you ate last month, do you think you would eat more, less, or the same number of meals next month with the higher price? (X is randomly assigned $1, $3, $5, or $7)<br><br>*Then,*<br><br>About how many more/less seafood meals do you think you will eat next month? |
| Question 2: Price down | Now suppose the price of your average seafood meal goes down by $X, but the price of all other foods stays the same. Compared to the [NUMBER] meals you ate last month, do you think you would eat more, less, or the same number of meals next month with the higher price? (X is randomly assigned $1, $2, $3, or $4)<br><br>*Then,*<br><br>About how many more/less seafood meals do you think you would eat next month with the higher price? |
| Question 3: Fish Kill | Thinking about seafood meals again, suppose that the average price of your seafood meals stay the same. Compared to the [NUMBER] meals you ate last month, do you think you would eat more, less, or the same number next month after the fish kill?<br><br>*Then,*<br><br>About how many more/less seafood meals do you think you would eat next month after the fish kill? |
| Question 4: Fish Kill w/Inspection | Now suppose the average price of your seafood meals stay the same. Compared to the [NUMBER] meals you ate last month, do you think you would eat more, less, or the same number next month after the fish kill and with the mandatory seafood inspection program?<br><br>*Then,* |

About how many more/less seafood meals do you think you would eat next month?

| | |
|---|---|
| Question 5: Fish Kill w/Inspection and price increase | Suppose that with the mandatory seafood inspection program the price of your portion of your average seafood meal goes up by $X, but the price of all other food stays the same. Compared to the [NUMBER] meals you ate last month, do you think that you would eat more, less, or the same number next month after the fish kill? (X is randomly assigned $1, $3, $5, or $7) |

*Then,*

About how many more/less seafood meals do you think you would eat next month?

**Table 7-2: Frequency Distributions for Price Increase and Price Decrease Scenarios**

| | Quantity Change | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Price Up | > 0 | 0 | -1 | -2 | -3 | -4 | -5 | < -5 |
| $1 | 5% | 79% | 7% | 5% | 1% | 1% | 1% | 1% |
| $3 | 4% | 56% | 16% | 12% | 5% | 3% | 1% | 3% |
| $5 | 4% | 46% | 20% | 17% | 6% | 4% | 0% | 4% |
| $7 | 2% | 40% | 23% | 17% | 6% | 6% | 2% | 4% |

| | Quantity Change | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Price Down | < 0 | 0 | 1 | 2 | 3 | 4 | 5 | > 5 |
| $1 | 3% | 72% | 10% | 7% | 4% | 1% | 2% | 1% |
| $2 | 2% | 57% | 10% | 15% | 7% | 4% | 3% | 2% |
| $3 | 4% | 53% | 9% | 13% | 7% | 6% | 3% | 4% |
| $4 | 3% | 47% | 8% | 20% | 6% | 5% | 4% | 4% |

**Table 7-3: Short Model Regression Results**

| Variable | Linear Model Coefficient | Linear Model (t-stat) | Nonlinear Model Coefficient | Nonlinear Model (t-stat) |
|---|---|---|---|---|
| pup | -.285 | (21.6) | -.061 | (19.0) |
| pdwn | -.424 | (20.1) | -.137 | (26.5) |
| maj | -1.17 | (9.0) | -.258 | (8.3) |
| min | -1.27 | (9.8) | -.272 | (8.8) |
| brc | -.081 | (0.6) | -.014 | (0.5) |
| ins | .082 | (0.7) | -.013 | (0.5) |
| sip | 1.07 | (9.2) | .274 | (9.7) |
| ipr | -.264 | (10.9) | -.060 | (10.2) |
| sigma | 2.39 | (100.3) | .588 | (101.7) |

**Table 7-4: Long Model Regression Results**

| Variable | | Linear Model Coefficient | (t-stat) | Nonlinear Model Coefficient | (t-stat) |
|---|---|---|---|---|---|
| pup | | -.29 | (8.1) | -.06 | (7.5) |
| pdwn | | -.45 | (7.6) | -.18 | (12.2) |
| maj | | -1.54 | (4.3) | -.30 | (3.5) |
| min | | -1.06 | (3.0) | -.25 | (2.9) |
| brc | | -.49 | (.37) | -.08 | (0.9) |
| ins | | .49 | (.36) | -.03 | (0.3) |
| sip | | .34 | (3.5) | .30 | (3.7) |
| ipr | | -.27 | (3.9) | -.07 | (4.0) |
| pup | * inc | .0003 | (.58) | .0002 | (1.3) |
| | * nc | .03 | (1.2) | -.008 | (1.3) |
| | * fish | -.08 | (2.9) | .004 | (0.6) |
| pdwn | * inc | .0001 | (.13) | -.0007 | (3.6) |
| | * nc | -.14 | (3.3) | -.01 | (1.1) |
| | * fish | .17 | (3.7) | .02 | (1.8) |
| maj | * inc | .0005 | (0.1) | .0002 | (0.1) |
| | * nc | .31 | (1.2) | -.04 | (0.6) |
| | * fish | .36 | (1.3) | .13 | (1.9) |
| min | * inc | -.004 | (0.9) | -.0002 | (0.1) |
| | * nc | .01 | (0.0) | -.08 | (1.3) |
| | * fish | .16 | (0.4) | .09 | (1.3) |
| brc | * inc | .005 | (1.0) | .0008 | (0.6) |
| | * nc | .28 | (1.1) | .06 | (0.9) |
| | * fish | -.18 | (0.7) | -.02 | (0.3) |
| cnt | * inc | -.0006 | (0.1) | .0006 | (0.5) |
| | * nc | -.65 | (2.5) | -.03 | (0.5) |
| | * fish | .19 | (0.8) | .03 | (0.5) |

| | | | | | |
|---|---|---|---|---|---|
| sip | * inc | .0004 | (0.1) | -.0005 | (0.4) |
| | * nc | -.17 | (0.7) | .02 | (0.4) |
| | * fish | -.05 | (0.2) | -.04 | (0.6) |
| ipr | * inc | .0008 | (0.8) | .0003 | (1.3) |
| | * nc | -.02 | (0.3) | -.12 | (0.9) |
| | * fish | -.07 | (1.3) | -.007 | (0.6) |
| sigma | | 2.8 | (100) | .58 | (102) |
| censored | | -x | | -1 | |

**Table 7-5: Consumer Surplus for the Short Linear Model**

(Average per person/per meal)

| | Total consumer surplus |
|---|---|
| Using price up coefficient | $8.56 |
| Using price down coefficient | $5.76 |

| | Change in consumer surplus due a fish kill | | | |
|---|---|---|---|---|
| | Major Fish Kill | | Minor Fish Kill | |
| | Price up | Price down | Price up | Price down |
| No information | -$3.14 | -$2.11 | -$3.31 | -$2.23 |
| Brochure | -$3.29 | -$2.21 | -$3.45 | -$2.32 |
| Brochure/counter | -$3.14 | -$2.11 | -$3.31 | -$2.23 |
| SIP | -$0.33 | -$0.22 | -$0.65 | -$0.44 |
| SIP + $1 price up | -$3.59 | -$2.41 | -$3.72 | -$2.51 |

**Table 7-6: Consumer Surplus for the Short Nonlinear Model**

(Average per person/per meal)

| | Total consumer surplus |
|---|---|
| Using price up coefficient | $16.51 |
| Using price down coefficient | $7.29 |

| | Change in consumer surplus due a fish kill | | | |
|---|---|---|---|---|
| | Major Fish Kill | | Minor Fish Kill | |
| Scenario | Price up | Price down | Price up | Price down |
| No information | -$1.70 | -$0.75 | -$1.80 | -$0.79 |
| Brochure | -$1.79 | -$0.79 | -$1.89 | -$0.83 |
| Brochure/counter | -$1.88 | -$0.83 | -$1.97 | -$0.87 |
| SIP | $0.10 | $0.05 | $0.01 | $0.00 |
| SIP + $1 price up | -$2.09 | -$0.92 | -$2.19 | -$0.97 |

# Chapter 8. Tables

**Table 8-1: Variable Description**

| Variable | Description |
|---|---|
| ΔPRICE | The change in price associated with the seafood inspection program |
| BEL × ΔPRICE | Believe in the price change (HIGHER=1) interacted with the price change |
| DBEL × ΔPRICE | Don't believe in the price change (HIGHER=0) interacted with the price change |
| PFIEBROC | Respondent received the Pfiesteria brochure (=1) |
| COUNTER | Respondent received the counter information (=1) |
| PRICE | Weighted average home and restaurant seafood meal price |
| INCOME | Household income (in thousands) |
| DE | 1 if Delaware respondent, 0 otherwise |
| MD | 1 if Maryland respondent, 0 otherwise |
| VA | 1 if Virginia respondent, 0 otherwise |
| PRISKB | Predicted baseline risk |
| PRISKSIP | Predicted risk with the seafood inspection program |
| ΔRISK | Change in risk (PRISKSIP-PRISKB) |
| UNDRPFST | 1 if respondent found the information very helpful, 0 otherwise |
| EASY | 1 if respondent found the hypothetical questions very easy, 0 otherwise |
| CLOSELY | 1 if respondent read information very closely, 0 otherwise |
| AMOUNT | 1 if respondent read all of the information, 0 otherwise |
| INFOWITH | 1 if respondent had information during interview, 0 otherwise |
| INSPECT | 1 if respondent found the inspection program very clear, 0 otherwise |
| STATE | Number of years lived in state of residence |
| AGE | Age of respondent |
| EDUC | Years of respondent schooling |
| CHILDREN | Number of children in the household |
| WHITE | 1 if respondent is white, 0 otherwise |
| MALE | 1 if respondent is male, 0 otherwise |
| CONCERN | 1 if respondent is very concerned about Pfiesteria, 0 otherwise |
| AVOID | 1 if respondent had ever avoided eating seafood because of Pfiesteria, 0 otherwise |
| REDUCE | 1 if a Pfiesteria outbreak would cause respondent would to reduce meals, 0 otherwise |
| SWIM | 1 if respondent agreed or strongly agreed with statement about swimming safety, 0 otherwise |
| BREATHE | 1 if respondent agreed or strongly agreed with statement about breathing safety, 0 otherwise |
| EAT | 1 if respondent agreed or strongly agreed with statement about seafood safety, 0 otherwise |

| | |
|---|---|
| DE | 1 if Delaware respondent, 0 otherwise |
| MD | 1 if Maryland respondent, 0 otherwise |
| VA | 1 if Virginia respondent, 0 otherwise |

**Table 8-2: Data Summary**

| Variable | Mean | Std.Dev. | Min | Max |
|---|---|---|---|---|
| ΔPRICE | 3.99 | 2.26 | 1 | 7 |
| BEL × ΔPRICE | 2.80 | 2.64 | 0 | 7 |
| DBEL × ΔPRICE | 1.19 | 2.19 | 0 | 7 |
| PFIEBROC | 0.72 | 0.45 | 0 | 1 |
| COUNTER | 0.37 | 0.48 | 0 | 1 |
| AVGPRICE | 10.33 | 4.69 | 1 | 26 |
| INCOME | 52.71 | 25.75 | 5 | 100 |
| DE | 0.12 | 0.33 | 0 | 1 |
| MD | 0.12 | 0.33 | 0 | 1 |
| VA | 0.10 | 0.31 | 0 | 1 |
| PRISKB | 0.0031 | 0.0300 | 0.0000 | 0.5748 |
| PRISKSIP | 0.0000 | 0.0000 | 0.0000 | 0.0001 |
| ΔRISK | -0.0031 | 0.0300 | 0.0000 | -0.5746 |
| UNDRPFST | 0.47 | 0.50 | 0 | 1 |
| EASY | 0.42 | 0.49 | 0 | 1 |
| CLOSELY | 0.30 | 0.46 | 0 | 1 |
| AMOUNT | 0.63 | 0.48 | 0 | 1 |
| INFOWITH | 0.34 | 0.47 | 0 | 1 |
| INSPECT | 0.51 | 0.50 | 0 | 1 |
| STATE | 30.15 | 20.52 | 0 | 82 |
| AGE | 46.10 | 15.56 | 18 | 100 |
| EDUC | 14.53 | 2.47 | 7 | 20 |
| CHILDREN | 0.73 | 1.06 | 0 | 5 |
| WHITE | 0.76 | 0.43 | 0 | 1 |
| MALE | 0.37 | 0.48 | 0 | 1 |
| CONCERN | 0.34 | 0.48 | 0 | 1 |
| AVOID | 0.23 | 0.42 | 0 | 1 |
| REDUCE | 0.53 | 0.50 | 0 | 1 |
| SWIM | 0.20 | 0.40 | 0 | 1 |
| BREATHE | 0.61 | 0.49 | 0 | 1 |
| EAT | 0.13 | 0.33 | 0 | 1 |
| Sample Size | 745 | | | |

**Table 8-3: Percentage of "for" Responses**

| ΔPRICE | Against | For | %For | Total |
|---|---|---|---|---|
| 1 | 29 | 164 | 84.97 | 193 |
| 3 | 35 | 143 | 80.34 | 178 |
| 5 | 48 | 138 | 74.19 | 186 |
| 7 | 66 | 122 | 64.89 | 188 |
| | 178 | 567 | 76.11 | 745 |

| ΔPRICE | Against | For (Very Sure Only) | %For | Total |
|---|---|---|---|---|
| 1 | 70 | 123 | 63.73 | 193 |
| 3 | 72 | 106 | 59.55 | 178 |
| 5 | 82 | 104 | 55.91 | 186 |
| 7 | 96 | 92 | 48.94 | 188 |
| | 320 | 425 | 57.05 | 745 |

**Table 8-4: Baseline Probit Regression Results**

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|---|---|---|---|---|---|---|---|---|
| Variable | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio |
| Constant | 1.084 | 4.754 | 0.897 | 3.535 | 1.472 | 2.996 | 1.188 | 2.270 |
| ΔPRICE | -0.115 | -4.807 | -0.113 | -4.645 | -0.117 | -4.669 | -0.134 | -5.172 |
| PFIEBROC | 0.239 | 1.845 | 0.252 | 1.881 | 0.276 | 1.975 | 0.224 | 1.554 |
| COUNTER | -0.235 | -1.813 | -0.236 | -1.794 | -0.288 | -2.114 | -0.207 | -1.481 |
| PRICE | 0.037 | 3.122 | 0.034 | 2.889 | 0.033 | 2.663 | 0.031 | 2.398 |
| ΔRISK | 1.261 | 0.638 | 1.107 | 0.573 | 1.445 | 0.748 | 2.334 | 1.191 |
| INCOME | -0.008 | -3.979 | -0.007 | -3.723 | -0.007 | -3.032 | -0.007 | -2.844 |
| DE | 0.134 | 0.558 | 0.141 | 0.578 | 0.143 | 0.574 | 0.181 | 0.708 |
| MD | -0.044 | -0.338 | 0.010 | 0.075 | 0.000 | 0.001 | 0.064 | 0.443 |
| VA | 0.249 | 1.787 | 0.274 | 1.936 | 0.260 | 1.751 | 0.309 | 2.037 |
| UNDRPFST | | | 0.200 | 1.808 | 0.211 | 1.826 | 0.225 | 1.892 |
| EASY | | | 0.281 | 2.562 | 0.279 | 2.451 | 0.323 | 2.750 |
| CLOSELY | | | -0.137 | -1.150 | -0.073 | -0.590 | 0.020 | 0.157 |
| AMOUNT | | | -0.089 | -0.716 | -0.095 | -0.728 | -0.053 | -0.391 |
| INFOWITH | | | 0.206 | 1.687 | 0.201 | 1.595 | 0.193 | 1.489 |
| INSPECT | | | -0.002 | -0.014 | -0.020 | -0.173 | -0.045 | -0.375 |
| STATE | | | | | -0.001 | -0.374 | -0.001 | -0.344 |
| AGE | | | | | -0.009 | -1.982 | -0.010 | -2.265 |
| EDUC | | | | | -0.002 | -0.082 | 0.013 | 0.524 |
| CHILDREN | | | | | 0.013 | 0.236 | 0.015 | 0.275 |
| WHITE | | | | | 0.205 | 1.562 | 0.285 | 2.040 |
| MALE | | | | | -0.616 | -5.614 | -0.552 | -4.823 |
| CONCERN | | | | | | | 0.197 | 1.484 |
| AVOID | | | | | | | 0.147 | 0.924 |
| REDUCE | | | | | | | 0.308 | 2.353 |
| SWIM | | | | | | | -0.087 | -0.595 |
| BREATHE | | | | | | | -0.192 | -1.479 |
| EAT | | | | | | | -0.261 | -1.744 |
| Ending LL | -395.33 | | -388.03 | | -368.39 | | -354.58 | |
| Beginning LL | -409.63 | | -409.63 | | -409.63 | | -409.63 | |
| Cases | 745 | | 745 | | 745 | | 745 | |

**Table 8-5: Probit Regression Results - Extensions**

| | Model 5 | | Model 6 (For = VS) | | Model 7 (NC=1) | | Model 8 (NC=0) | |
|---|---|---|---|---|---|---|---|---|
| Variable | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio | Coeff. | t-ratio |
| Constant | 1.416 | 2.868 | -0.468 | -1.045 | 1.235 | 2.141 | 2.152 | 2.583 |
| ΔPRICE | -0.124 | -4.839 | -0.023 | -1.051 | -0.143 | -4.630 | -0.105 | -2.474 |
| BEL × ΔPRICE | -0.091 | -2.793 | | | | | | |
| DBEL × ΔPRICE | | | | | | | | |
| PFIEBROC | 0.280 | 1.994 | 0.368 | 2.964 | 0.143 | 0.777 | 0.326 | 1.343 |
| COUNTER | -0.276 | -2.021 | 0.024 | 0.201 | -0.297 | -1.871 | -0.353 | -1.460 |
| PRICE | 0.032 | 2.609 | 0.032 | 2.922 | 0.049 | 2.965 | 0.032 | 1.548 |
| ΔRISK | 1.564 | 0.803 | -0.727 | -0.386 | -3.776 | -1.059 | 4.898 | 1.979 |
| INCOME | -0.007 | -3.040 | -0.005 | -2.591 | -0.005 | -1.522 | -0.007 | -1.732 |
| DE | 0.156 | 0.628 | 0.154 | 0.710 | | | | |
| MD | 0.029 | 0.210 | -0.034 | -0.267 | | | | |
| VA | 0.276 | 1.850 | 0.195 | 1.454 | | | | |
| UNDRPFST | 0.201 | 1.731 | 0.263 | 2.532 | 0.388 | 2.745 | 0.334 | 1.662 |
| EASY | 0.281 | 2.462 | 0.403 | 3.971 | 0.450 | 3.116 | 0.337 | 1.703 |
| CLOSELY | -0.060 | -0.482 | 0.027 | 0.235 | -0.201 | -1.255 | -0.124 | -0.583 |
| AMOUNT | -0.109 | -0.830 | -0.156 | -1.335 | -0.049 | -0.302 | 0.090 | 0.400 |
| INFOWITH | 0.217 | 1.706 | 0.369 | 3.224 | 0.173 | 1.177 | 0.148 | 0.687 |
| INSPECT | -0.004 | -0.030 | 0.273 | 2.555 | -0.029 | -0.206 | -0.209 | -1.018 |
| STATE | -0.001 | -0.405 | -0.001 | -0.180 | 0.003 | 0.776 | -0.004 | -0.752 |
| AGE | -0.009 | -1.922 | 0.003 | 0.794 | -0.013 | -2.329 | -0.013 | -1.657 |
| EDUC | -0.001 | -0.040 | -0.015 | -0.673 | 0.019 | 0.599 | -0.037 | -0.892 |
| CHILDREN | 0.017 | 0.325 | 0.056 | 1.141 | -0.051 | -0.749 | -0.041 | -0.457 |
| WHITE | 0.217 | 1.646 | 0.085 | 0.714 | 0.100 | 0.582 | 0.461 | 2.040 |
| MALE | -0.625 | -5.671 | -0.355 | -3.484 | -0.701 | -4.909 | -0.576 | -2.995 |
| Ending LL | -367.56 | | -462.47 | | -228.52 | | -124.22 | |
| Beginning LL | -409.63 | | -508.97 | | -263.40 | | -146.22 | |
| Cases | 745 | | 745 | | 481 | | 264 | |

**Table 8-6: Valuation Functions and Willingness to Pay**

| | Model 3 | | | Model 3 with Sample Selection | | |
|---|---|---|---|---|---|---|
| Variable | Coeff. | t-ratio | Elasticity | Coeff. | t-ratio | Elasticity |
| Constant | 12.58 | 2.87 | | 3.28 | 0.47 | |
| PFIEBROC | 2.36 | 1.85 | | 2.25 | 1.67 | |
| COUNTER | -2.46 | -2.00 | | -2.40 | -1.79 | |
| PRICE | 0.28 | 2.33 | 0.032 | 0.26 | 1.92 | 0.025 |
| ΔRISK | 12.35 | 0.74 | | 12.61 | 1.00 | |
| INCOME | -0.06 | -2.59 | -0.033 | -0.06 | -2.30 | -0.028 |
| DE | 1.22 | 0.57 | | 1.44 | 0.63 | |
| MD | 0.00 | 0.00 | | 0.35 | 0.28 | |
| VA | 2.22 | 1.66 | | 2.26 | 1.59 | |
| UNDRPFST | 1.81 | 1.70 | | 1.70 | 1.48 | |
| EASY | 2.38 | 2.14 | | 2.21 | 1.77 | |
| CLOSELY | -0.63 | -0.59 | | -0.75 | -0.65 | |
| AMOUNT | -0.82 | -0.72 | | -0.56 | -0.45 | |
| INFOWITH | 1.72 | 1.53 | | 1.76 | 1.44 | |
| INSPECT | -0.17 | -0.17 | | -0.11 | -0.10 | |
| STATE | -0.01 | -0.38 | -0.004 | -0.02 | -0.49 | -0.004 |
| AGE | -0.08 | -1.78 | -0.038 | -0.10 | -1.90 | -0.044 |
| EDUC | -0.02 | -0.08 | -0.003 | 0.20 | 0.76 | 0.028 |
| CHILDREN | 0.11 | 0.24 | | -0.08 | -0.16 | |
| WHITE | 1.75 | 1.46 | | 3.17 | 1.71 | |
| MALE | -5.27 | -3.73 | | -4.91 | -3.19 | |
| WTP | $10.76 | 7.13 | | $4.32 | 1.19 | |
| Upper 90% C.I. | $13.20 | | | $10.21 | | |
| Lower 90% C.I. | $8.31 | | | -$1.57 | | |

## List of Appendices

## Appendix A. Pfiesteria Literature Review

Most people formed their initial characterizations of the dinoflagellate Pfiesteria piscicida during the media feeding frenzy of the years 1995 to 1997 (Semans, 1998). Some scientists and the media have described the organism as an "ambush predator" and "the cell from hell." Other sources counter these assessments as alarmist and unsubstantiated claims. Since the organism is so complex in its morphology and so much is still unknown (Burkholder, 1995), the general public attempts to fit the Pfiesteria problem into some realm of past experience, and old, traditional cultural and environmental models of understanding are ill–suited to this particular issue. Traditional models do not conform to the true nature of the Pfiesteria risk and so leads to mistaken conclusions and inappropriate action (Kempton and Falk, 2001). This appendix seeks to summarize the research reported to date on Pfiesteria piscicida's general characteristics and its proposed risk to fish species and human health.

Pfiesteria is one of many organisms called dinoflagellates that exhibit toxic life phases and dual plant/animal characteristics. A dinoflagellate is a microorganism with both plant and animal characteristics, which moves about by means of beating flagella (whip–like features). They often exhibit toxic life phases in which they secrete a neurotoxin that can kill or stun fish and cause irritation to other animals in the vicinity, including humans. One fairly well known example is G. breve, associated with red tide events, that causes fish kills and respiratory irritation in humans from breathing the sea spray or water vapor in the air in the vicinity of the red tide that contains the toxin (Burkholder, 1992; Florida Department of Environmental Protection, 1997).

Pfiesteria was first identified in 1988 by Dr. Ed Noga's laboratory at NC State University, and was later proposed to have a complicated life cycle of more than twenty forms. Two different toxins, one fat-soluble and the other water soluble, have been identified as released by this organism. The fat soluble toxin causes skin lesions in fish and the water soluble is a neurotoxin (Buck et al., 1997; Burkholder et al., 1992; Burkholder and Glasgow, 1995).

Fish kills at various locations along the eastern seaboard, especially in shallow estuarine systems such as the Pamlico and Neuse, have accelerated since the 1980's. Multiple causes of these kills have been reported: nutrient and sediment loading from nonpoint source pollutant runoff, low dissolved oxygen, and toxins from harmful algae blooms (including *Pfiesteria).* Once levels of nutrients such as nitrogen and phosphorus are elevated, phytoplankton react with accelerated growth, or "blooms". Since many zooplankton and dinoflagellate organisms feed on the phytoplankton, they "bloom" as well. These blooms use up oxygen in the upper layers of the water column, and as the phytoplankton die and sink to the bottom, resulting bacterial decomposition use up available dissolved oxygen in the bottom layers as well. This low dissolved oxygen is a major contributor to fish stress and death. Tidal characteristics of estuarine areas such as the Neuse cause "stratification" of the water column (i.e., denser, cooler saline water stays near the bottom, and warmer, fresh water stays near the top). This condition only exacerbates the low dissolved oxygen problem by preventing mixing that could replenish oxygen. The situation is alleviated with discharge, mixing, and flushing events such as storms, which destratify the water column and flush the blooms out of the system (Paerl et al., 1998).

Other "*Pfiesteria*–like" organisms have been associated with fish kill waters, as well as "red tide" associated organisms. This assemblage of organisms are called "nuisance dynoflagellates and (cynobacteria)" (Paerl et. al., 1998, p.18; Burkholder et al., 1992, Mallin, 1991, Christian, 1986). The basic premise of Pearl et al. was that there was a distinct positive correlation between eutrophication, hypoxic events, and fish kills. They mention toxic dynoflagellate occurrences as being a consequence of degraded water quality, but do not attribute fish deaths to the actions or influences of dinoflagellates. Burkholder, Mallin, and Glasgow (1999) challenge Paerl et al.'s assessment of the causes of fish kills, accusing them of omitting evidence that she and her colleagues had published which attributed fish deaths to Pfiesteria. Burkholder, Mallin, and Glasgow state that toxic Pfiesteria "… should be implicated as the primary causative agent(s) in the absence of other known lethal factors within the kill zone" (p.308).

The tell–tale sores and ulcers found on fish in the kill areas have been attributed to both a fungus and Pfiesteria. Blazer et al. (1999) sought to clarify the causal agent of ulcerative skin lesions on Menhaden (the fish species that is often dominant in fish kills). Their study is directed at the hypothesis that *Pfiesteria* and/or its toxins are a cause of these lesions, and the reports that implicated the organism as a cause of major estuarine fish kills. The investigation revealed that " ...all of the ulcerative lesions collected in both Virginia and Maryland waters contained ... deeply penetrating fungal hyphae" (p. 343). They further state that "... scientific evidence for the relationship of these lesions with toxic dinoflagellates is lacking, ... (and that) ... factors other than toxic dinoflagellates need to be considered as causes or initiators of these lesions" (p. 347, 348). The lesions were attributed to fungal infections, due to the " ...consistent presence of an invasive fungal pathogen" in the lesions (p.348).

In a later study by Dykstra and Kane (2000), the relationship between Pfiesteria, its toxins, and lesions on Menhaden were again investigated. They concurred that "... Pfiesteria-like organisms have not been reported from menhaden skin or from within menhaden lesions, ... and large menhaden kills have occurred that cannot be attributed to Pfiesteria (p. 23). They add that the Pfiesteria toxin as yet cannot be isolated and identified in the marine environment.

Stressful environmental conditions tend to make larger organisms such as fish more susceptible to infections. The secretions of live fish have been reported to act as a stimulus that promotes Pfiesteria's mutation into the toxic stage. All other life phases of the organism are stated to be benign. In this toxic stage, the organism is said to behave as an "ambush predator", actively feeding on fish tissues (Burkholder et al., 1992). It should be noted, however, that since live fish and Pfiesteria coexist uneventfully during all other life phases of the organism, some factors associated with degraded water quality and secretions of stressed fish may have something to do with this transformation into a predatory stage. It may be best to describe the organism as an opportunist, feeding on its normal prey of phytoplankton during most of its life cycle, and switching to fish tissues when it is advantageous to do so (Steidinger et. al, 1997).

The major human health risk of exposure to Pfiesteria is short–term memory loss or cognitive dysfunction for three to six months. Pfiesteria has been shown to seriously, albeit temporarily, affect health in some who have found themselves in direct contact with the organism in its toxic phase (Burkholder et al., 1993; Levin, 1997). It cannot, however, be extrapolated that such health effects extend to contact with non–fishkill waters and the consumption of uninvolved species (the most common species found in the kill areas were menhaden, a nonfood fish), especially those with no sores or lesions.

In his investigation into human health risks due to Pfiesteria Griffith's (1999) finds little correlation between Pfiesteria and the health of crabbers in North Carolina. Griffith argues that a nonexistent, or minimal, human health risk can be exaggerated by the media, popular writers, public officials, and the scientists with whom the research is associated. It is clear that any of the above parties could have vested interests: journalists want to sell news, authors want to sell books, politicians and officials want public acclaim and votes, and scientists want peer acclaim and funding. Burkholder and Glasgow (1999) provide a strongly worded rebuttal to Griffith (1999).

Kempton and Falk's (2001) find that a significant proportion of respondents thought consumption of seafood puts them at risk of the neurotoxin's effects. Most of the respondents in Kempton and Falk's (2001) study characterize the organism in a very different way from biologists who are familiar with the research. The respondents (public) describe it as a parasite or disease in fish, neither of which is true. Biologists and the public also disagree as to how Pfiesteria harms people, as biologists concur that only direct contact with dead fish, fish kill waters, or the air above these waters, can cause harm. The public believed that it both harmed the environment generally and harmed people if they ate seafood.

Misconceptions by the public are understandable in light of misleading media articles on the issue include a USA Today story that presented Pfiesteria as a toxic microorganism living inside fish that cause fish disease, the major symptom of which are the skin sores or lesions. Another series of articles on the issue were in the Raleigh News and Observer in March 1996 entitled "Sold Down the River", in which environmental groups attempt to describe a state led conspiracy to bury the issue and place people in danger of health risks to protect special interest groups. In fact, consumption of Pfiesteria-affected fish has not been shown to cause detrimental health affects in any study, as all deal with exposure to toxins in aerosol form. Public health officials have continuously warned the public not to eat fish from fish-kill areas or fish with lesions or sores, and not to come in direct contact with fish kill waters. This is not just due to Pfiesteria but the danger of bacterial infection (Semans, 1998).

In conclusion, the complexities of the organism, the newness of the issue, and the motivations and dramatization by media and scientists, have all combined to leave the public with a legacy of misinformation. The resulting exaggerated perception of risk has negatively impacted both regional seafood sales and consumption of seafood products, especially local ones. Unfortunately, Kempton and Falk (2001) show that even after respondents to the survey were given a briefing seminar to show them the facts of the issue, their initial perceptions remained essentially unchanged. Once people form opinions and perceptions about a new phenomenon, it is very difficult to alter, even if the perceptions are entirely false in terms of scientific fact.

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## Appendix B. First Telephone Survey Instrument

Q: INTRO

Hello, my name is ______, and I'm calling from the East Carolina University Survey Research Laboratory. We are conducting a short survey to better understand the seafood consumption patterns of people in your state and to get your opinions about seafood safety. I need to speak to someone in your household over 18 who eats seafood. Is that person you?

INTERVIEWER: ENTER 1 TO CONTINUE. IF THERE IS NO ONE WHO EATS SEAFOOD IN THE HOUSEHOLD, THEN WE DO NOT WANT TO INTERVIEW THEM. WE ONLY WANT PEOPLE WHO ACTUALLY EAT SEAFOOD. IF THERE IS SOMEONE WHO EATS SEAFOOD, BUT THEY ARE NOT HOME, SCHEDULE A CALLBACK TO TALK TO THAT PERSON.

**Q: OFTEN**

The first question deals with how often you eat seafood. Please think about the seafood meals that you ate at your home and at restaurants. Think about finfish, like flounder, and shellfish, like oysters, but don't include canned seafood like canned tuna. Do you eat seafood ...

INTERVIEWER: FROZEN SEAFOOD, LIKE FISHSTICKS OR TV DINNERS ARE OKAY!

1 About once or twice a year?
2 About once or twice a month?
3 About once a week?
4 More than once a week?

**Q: WEEK**

For the next several questions, consider the seafood that you recently ate, other than canned seafood. Only include meals you ate at home and at restaurants. About how many seafood meals did you eat last week?

INTERVIEWER: THEY MUST NOT INCLUDE MEALS ATE AT SOMEONE ELSE'S HOME.

MONTHa = WEEK * 4

**Q: MONTH**

About how many seafood meals did you eat last month?

(IF ASKED, INCLUDING THE MEALS FROM LAST WEEK)

IF (MONTH >= 0)  NUMNUMBER = MONTH
if (answer >= 0) skip to TYPICAL

**Q: LSTMONTH**

Did you eat about [MONTHa] seafood meals last month?

1 Yes
2 No
3 DK/NA

IF (MONTH >= 0)  NUMBER = MONTH
IF (LSTMONTH = 1)  NUMBER = MONTHa
IF (ANSWER = 1) SKIP TO TYPICAL

**Q: MORLESS**

Did you eat more or less?

1 More
2 Less
3 DK/NA

IF (MONTH >= 0)  NUMBER = MONTH
IF (LSTMONTH = 1)  NUMBER = MONTHa
if (morless = 3)  NUMBER = MONTHa
IF (ANSWER = 1) SKIP TO MORE
if (answer = 3) skip to TYPICAL

**Q: LESS**

About how many less?

IF (MONTH >= 0)  NUMBER = MONTH
IF (LSTMONTH = 1)  NUMBER = MONTHa
IF (LESS >= 0)  NUMBER = (MONTHA - LESS)
if (morless = 3)  NUMBER = MONTHa
skip to TYPICAL

**Q: MORE**

About how many more?

IF (MONTH >= 0)  NUMBER = MONTH

IF (LSTMONTH = 1)  NUMBER = MONTHa
IF (MORE >= 0)  NUMBER = (MORE + MONTHA)
if (morless = 3)  NUMBER = MONTHa

**Q: TYPICAL**

Do you typically eat about [ NUMBER] seafood meals every month?

1 Yes
2 No
3 DK/NA

IF (ANSWER = 1 &  NUMBER = 0) SKIP TO THANKS
IF (ANSWER = 2 &  NUMBER > 0) SKIP TO TYPMONTH
IF (ANSWER = 1 &  NUMBER > 0) SKIP TO TYPES
IF (ANSWER = 3 &  NUMBER = 0) SKIP TO THANKS
IF (ANSWER = 3 &  NUMBER > 0) SKIP TO TYPMONTH

**Q: TYPMONTH**

About how many seafood meals do you typically eat every month?

**Q: TYPES**

Now we'll talk about the types of seafood you eat. In the last month, or in a typical month if you didn't eat any seafood in the last month, did you eat finfish (ie. flounder), shellfish (ie. crabs), or both?

1 Finfish
2 Shellfish
3 Both
4 DK/NA

if (answer = 2) skip to  SHELL

**Q: FINFISH**

About how many finfish meals did you eat last month?

**Q: KINDFIN**

What kinds of finfish did you eat in the last month?

INTERVIEWER: CHECK ALL THAT APPLY. RESPONSES ARE ALPHABETIZED. IF THEY DON'T KNOW, READ CATEGORIES TO TRY TO TRIGGER MEMORY BEFORE ENTERING "DK/NA".

1 Bass (largemouth,smallmouth)
2 Bass (sea)
3 Bluefish
4 Carp
5 Catfish
6 Cod
7 Croaker
8 Flounder
9 Grouper
10 King Mackerel
11 Mahi Mahi
12 Mullet
13 Perch
14 Orange Roughy
15 Pollock
16 Pompano
17 Red Drum (redfish)
18 Rockfish (striped bass)
19 Salmon
20 Shark
21 Snapper (red, etc.)
22 Sole
23 Spanish Mackerel
24 Spot
25 Sushi
26 Swordfish
27 Tilapia
28 Trout (Saltwater: Sea trout)
29 Trout (Freshwater:speckled,brown,lake,etc.)
30 Tuna
31 Whitefish
32 Whiting
33 Other
34 DK/NA

**Q: COOK**

How was the finfish cooked?

INTERVIEWER: CHECK ALL THAT APPLY.

1 Baked
2 Blackened
3 Boiled
4 Broiled
5 Fried
6 Grilled
7 Raw
8 Smoked
9 Steamed
10 Stewed
11 Other
12 DK/NA

if (types = 1) skip to OWNHOME

**Q: NUMSHELL**

About how many shellfish meals did you eat last month?

**Q: KINDSHEL**

What kinds of shellfish did you eat?

INTERVIEWER: CHECK ALL THAT APPLY. IF THEY DON'T KNOW, READ CATEGORIES TO TRY TO TRIGGER MEMORY BEFORE ENTERING "DK/NA". IF THEY CHOOSE "DK/NA", CHECK THAT BOX LAST.

1 Clams
2 Crabs
3 Crayfish
4 Lobster
5 Mussels
6 Octopus
7 Oysters
8 Scallops
9 Shrimp
10 Squid (Calamari)
11 Other
12 DK/NA

**Q: SHELCOOK**

How was the shellfish cooked?

INTERVIEWER: CHECK ALL THAT APPLY

1 Baked
2 Blackened
3 Boiled
4 Broiled
5 Fried
6 Grilled
7 Raw
8 Smoked
9 Steamed
10 Stewed
11 Other
12 DK/NA

**Q: OWNHOME**

Of the total seafood meals you ate in the last month at your home and at restaurants, about how many were cooked at your home?
if (ownhome > 0) skip to VENDOR

**Q: RESTAUR**

Were all of your seafood meals at a restaurant?

1 Yes
2 No
3 DK/NA

IF (OWNHOME = 0) skip to FISHTRIP

**Q: VENDOR**

Of the seafood meals cooked at your home, how many were prepared from seafood bought from a vendor at the side of the road?

**Q: MARKET**

How many were from a fresh seafood market (not a grocery store)?

**Q: GROCERY**

How many were from the seafood counter at the grocery store?

**Q: FROZEN**

How many were from the frozen seafood section at the grocery store?

**Q: FISH**

How many were from fish that you or someone in your household caught?

**Q: FISHTRIP**

How many fishing trips did you or someone in your household take last month after which you ate part or all of your catch?

if (ownhome = 0 & answer = 0) skip to RESTAU
if (answer = 0) skip to PRICE

**Q: MILES**

About how many miles did you or someone in your household drive from your home to the place they usually fish?

**Q: HOURS**

About how many hours do you or someone in your household usually fish?

if (ownhome = 0) skip to RESTAU

**Q: PRICE**

Now consider the prices of seafood that was cooked in your home. Think about the average or typical amount of money you spent on YOUR portion of each home-cooked seafood meal last month.

INTERVIEWER: ENTER 1 TO CONTINUE

PRICES = RAND (1 2)
IF (PRICES = 2) skip to NINE

**Q: FIVE**

Was the price higher than $5, lower than $5, or about $5?

1 Higher
2 Lower
3 About $5
4 DK/NA

IF (ANSWER = 1) SKIP TO HIGHERa
IF (ANSWER = 2) SKIP TO LOWERa
IF (ANSWER = 3) SKIP TO RESTAU
IF (ANSWER = 4) SKIP TO HIGHERa

**Q: NINE**

Was the price higher than $9, lower than $9, or about $9?

1 Higher
2 Lower
3 About $9
4 DK/NA

IF (ANSWER = 1) SKIP TO HIGHERb
IF (ANSWER = 2) SKIP TO LOWERb
IF (ANSWER = 3) SKIP TO RESTAU
IF (ANSWER = 4) SKIP TO HIGHERb

**Q: HIGHERa**

Was it higher than … (read list, wait for a "no" and enter that NUMBER)

1 $6

2 $7
3 $8
4 $9
5 $10
6 $11
7 $12
8 $13
9 $14
10 $15
11 $16
12 $17
13 $18
14 $19
15 $20
16 more than $20
17 DK/NA

skip to RESTAU

**Q: LOWERa**

Was it lower than...(read list, wait for a "no" and enter that NUMBER)

1 $4
2 $3
3 $2
4 $1
5 DK/NA

Skip to RESTAU

**Q: HIGHERb**

Was it higher than ... (read list, wait for a "no" and enter that NUMBER)

1 $10
2 $11
3 $12
4 $13
5 $14
6 $15
7 $16
8 $17
9 $18
10 $19
11 $20

12 more than $20
13 DK/NA

Skip to RESTAU

**Q: LOWERb**

Was it lower than ... (read list, wait for a "no" and enter that NUMBER)

1 $8
2 $7
3 $6
4 $5
5 $4
6 $3
7 $2
8 $1
9 DK/NA

**Q: RESTAU**

Of the seafood meals you ate last month, how many were restaurant meals?

IF (ANSWER = 0) SKIP TO NXTMONTH
MONEY = RAND (1 2)
IF (MONEY = 2) skip to MONEYb

**Q: MONEYa**

Consider the money you spent on seafood at a restaurant last month, including appetizers and main dishes. Think about the average or typical amount of money you spent on YOUR portion of each seafood meal. Do you think it was higher than $9, lower than $9, or about $9?

1 Higher
2 Lower
3 About $9
4 DK/NA

IF (ANSWER = 1) SKIP TO HIGHERc
IF (ANSWER = 2) SKIP TO LOWERc
IF (ANSWER = 3) SKIP TO NXTMONTH
IF (ANSWER = 4) SKIP TO HIGHERc

**Q: MONEYb**

Consider the money you spent on seafood at a restaurant last month, including appetizers and main dishes. Think about the average or typical amount of money you spent on YOUR portion of each seafood meal. Do you think it was higher than $13, lower than $13, or about $13?

1 Higher
2 Lower
3 About $13
4 DK/NA

IF (ANSWER = 1) SKIP TO HIGHERd
IF (ANSWER = 2) SKIP TO LOWERd
IF (ANSWER = 3) SKIP TO NXTMONTH
IF (ANSWER = 4) SKIP TO HIGHERd

**Q: HIGHERc**

Was it higher than ... (read list, wait for a "no" and enter that NUMBER)

1 $10
2 $11
3 $12
4 $13
5 $14
6 $15
7 $16
8 $17
9 $18
10 $19
11 $20
12 $21
13 $22
14 $23
15 $24
16 $25
17 more than $25
18 DK/NA

SKIP TO NXTMONTH

**Q: LOWERc**

Was it lower than ... (read list, wait for a "no" and enter that NUMBER)

1 $8
2 $7

3 $6
4 $5
5 $4
6 $3
7 $2
8 $1
9 DK/NA

SKIP TO NXTMONTH

**Q: HIGHERd**

Was it higher than...(read list, wait for a "no" and enter that NUMBER)

1 $14
2 $15
3 $16
4 $17
5 $18
6 $19
7 $20
8 $21
9 $22
10 $23
11 $24
12 $25
13 more than $25
14 DK/NA

SKIP TO NXTMONTH

**Q: LOWERd**

Was it lower than ... (read list, wait for a "no" and enter that NUMBER)

1 $12
2 $11
3 $10
4 $9
5 $8
6 $7
7 $6
8 $5
9 $4
10 $3
11 $2

12 $1
13 DK/NA

**Q: NXTMONTH**

Thinking about the seafood meals you ate last month again, if the average price of your seafood meals stay the same, do you think you will eat more, less, or the same NUMBER of seafood meals next month?

1 More
2 Less
3 Same
4 DK/NA

if (answer = 3) skip to ENTER
IF (ANSWER = 4) SKIP TO ENTER

**Q: EATMONTH**

About how many more/less seafood meals do you think you will eat next month?

**Q: ENTER**

INTERVIEWER: ENTER 1 TO CONTINUE

PRICEUP = RAND (1 4)
IF (PRICEUP = 2) SKIP TO PRICEb
IF (PRICEUP = 3) SKIP TO PRICEc
IF (PRICEUP = 4) SKIP TO PRICEd

**Q: PRICEa**

Seafood prices change over time. For example, if a lot of fish are caught, prices go down. When fewer fish are caught, prices go up. Suppose the price of your portion of your average seafood meal goes up by $1, but the price of all other foods stays the same. Compared to the [ NUMBER] meals you ate last month, do you think you would eat more, less, or the same NUMBER of meals next month with the higher price?

1 More
2 Less
3 Same
4 DK/NA

if (answer = 3) skip to ENTER2
SKIP TO MEALS

**Q: PRICEb**

Seafood prices change over time. For example, if a lot of fish are caught, prices go down. When fewer fish are caught, prices go up. Suppose the price of your portion of your average seafood meal goes up by $3, but the price of all other foods stays the same. Compared to the [NUMBER] meals you ate last month, do you think you would eat more, less, or the same number of meals next month with the higher price?

1 More
2 Less
3 Same
4 DK/NA

if (answer = 3) skip to ENTER2
SKIP TO MEALS

**Q: PRICEc**

Seafood prices change over time. For example, if a lot of fish are caught, prices go down. When fewer fish are caught, prices go up. Suppose the price of your portion of your average seafood meal goes up by $5, but the price of all other foods stays the same. Compared to the [NUMBER] meals you ate last month, do you think you would eat more, less, or the same number of meals next month with the higher price?

1 More
2 Less
3 Same
4 DK/NA

if (answer = 3) skip to ENTER2
SKIP TO MEALS

**Q: PRICEd**

Seafood prices change over time. For example, if a lot of fish are caught, prices go down. When fewer fish are caught, prices go up. Suppose the price of your portion of your average seafood meal goes up by $7, but the price of all other foods stays the same. Compared to the [ NUMBER] meals you ate last month, do you think you would eat more, less, or the same NUMBER of meals next month with the higher price?

1 More
2 Less
3 Same
4 DK/NA

if (answer = 3) skip to ENTER2

SKIP TO MEALS

**Q: MEALS**

About how many more/less seafood meals do you think you would eat next month with the higher price?

**Q: ENTER2**

INTERVIEWER ENTER 1 TO CONTINUE

PRICDOWN = RAND (1 4)
IF (PRICDOWN = 2) SKIP TO DOWNb
IF (PRICDOWN = 3) SKIP TO DOWNc
IF (PRICDOWN = 4) SKIP TO DOWNd

**Q: DOWNa**

Now suppose the price of your average seafood meal goes down by $1 but the price of all other food stays the same. Compared to the [ NUMBER] seafood meals you ate last month, do you think you would eat more, less, or the same NUMBER next month with the lower price?

1 More
2 Less
3 Same
4 DK/NA

IF (ANSWER = 3) SKIP TO SAFE
IF (ANSWER = 1) SKIP TO LOWER
IF (ANSWER = 2) SKIP TO LOWER
IF (ANSWER = 4) SKIP TO LOWER

**Q: DOWNb**

Now suppose the price of your average seafood meal goes down by $2 but the price of all other food stays the same. Compared to the [ NUMBER] seafood meals you ate last month, do you think you would eat more, less, or the same NUMBER next month with the lower price?

1 More
2 Less
3 Same
4 DK/NA

IF (ANSWER = 3) SKIP TO SAFE

IF (ANSWER = 1) SKIP TO LOWER
IF (ANSWER = 2) SKIP TO LOWER
IF (ANSWER = 4) SKIP TO LOWER

**Q: DOWNc**

Now suppose the price of your average seafood meal goes down by $3 but the price of all other food stays the same. Compared to the [ NUMBER] seafood meals you ate last month, do you think you would eat more, less, or the same NUMBER next month with the lower price?

1 More
2 Less
3 Same
4 DK/NA

IF (ANSWER = 3) SKIP TO SAFE
IF (ANSWER = 1) SKIP TO LOWER
IF (ANSWER = 2) SKIP TO LOWER
IF (ANSWER = 4) SKIP TO LOWER

**Q: DOWNd**

Now suppose the price of your average seafood meal goes down by $4 but the price of all other food stays the same. Compared to the [ NUMBER] seafood meals you ate last month, do you think you would eat more, less, or the same NUMBER next month with the lower price?

1 More
2 Less
3 Same
4 DK/NA

IF (ANSWER = 3) SKIP TO SAFE
IF (ANSWER = 1) SKIP TO LOWER
IF (ANSWER = 2) SKIP TO LOWER
IF (ANSWER = 4) SKIP TO LOWER

**Q: LOWER**

About how many more/less seafood meals do you think you would eat next month with the lower price?

**Q: SAFE**

The next few questions are about how safe you think seafood is to eat. When you answer these questions think about the type of illness that would make you go to the doctor, miss work, or miss some other activity, after you ate. Try not to think about allergic reactions or long-term problems from eating. Do you think seafood is ...

1 Very safe to eat
2 Somewhat safe to eat
3 Somewhat unsafe to eat
4 Very unsafe to eat
5 DK/NA

**Q: SICKMOST**

Now compare the safety of seafood with poultry, including chicken and turkey, and meat, including beef and pork. Which food do you think is MOST likely to make you sick if you ate it?

1 Seafood
2 Poultry
3 Meat
4 DK/NA

**Q: SICKLEAS**

Of the same choices, which food do you think is least likely to make you sick if you ate it?

1 Seafood
2 Poultry
3 Meat
4 DK/NA

**Q: CHANCE**

To get a better idea of how safe you think you are from eating seafood, consider the seafood meals you expect to eat next month. What do you think are your chances of getting sick from eating these meals? Do you think they are …

1 Very likely
2 Somewhat likely
3 Somewhat not likely
4 Not likely at all
5 DK/NA

**Q: PERCENT**

Do you think your chances are greater or less than 1%?

1 Greater
2 Less
3 About 1%
4 DK/NA

if (answer = 1) skip to HANDLING
if (answer = 3) skip to HANDLING
CHANSICK = RAND  (1 4)
IF (CHANSICK = 2) SKIP TO CHAN2
IF (CHANSICK = 3) SKIP TO CHAN3
IF (CHANSICK = 4) SKIP TO CHAN4

**Q: CHAN1**

This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in 1,000?

1 Greater than
2 Less than
3 About that
4 DK/NA

SKIP TO HANDLING

**Q: CHAN2**

This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in 10,000?

1 Greater than
2 Less than
3 About that
4 DK/NA

SKIP TO HANDLING

**Q: CHAN3**

This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in 100,000?

1 Greater than

2 Less than
3 About that
4 DK/NA

SKIP TO HANDLING

**Q: CHAN4**

This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in 1,000,000?

1 Greater than
2 Less than
3 About that
4 DK/NA

**Q: HANDLING**

For the next few questions, please tell me how concerned you are you about the following problems that might affect the safety of seafood. Tell me whether you are very concerned, somewhat concerned, or not concerned. How concerned are you about poor seafood handling practices?

1 Very concerned
2 Somewhat concerned
3 Not concerned
4 DK

**Q: FRESH**

How concerned are you about the freshness of seafood?

1 Very concerned
2 Somewhat concerned
3 Not concerned
4 DK

**Q: DISEASE**

How concerned are you about diseases in fish?

1 Very concerned
2 Somewhat concerned
3 Not concerned
4 DK

**Q: PFIESTER**

Have you ever heard about Pfiesteria {pronounced fis-teer-ee-ah}?

1 Yes
2 No
3 DK/NA

IF (ANSWER = 2) SKIP TO STATE

**Q: PFIEST**

To the best of your knowledge, would you say that Pfiesteria {pronounced fis-teer-ee-ah} is ...

1 A form of pollution
2 A disease in fish
3 A toxic organism
4 A predator that attacks fish
5 A parasite in fish
6 DK/NA

**Q: OUTBREAK**

Pfiesteria is a potentially toxic organism that has been associated with fish kills in coastal waters from Delaware to North Carolina. To the best of your knowledge, have outbreaks of Pfiesteria {pronounced fis-teer-ee-ah} occurred in [state] during the past month?

1 Yes
2 No
3 DK/NA

**Q: CONCERN**

How concerned are you about Pfiesteria {pronounced fis-teer-ee-ah}?

1 Very concerned
2 Somewhat concerned
3 Not concerned
4 DK

**Q: AVOID**

Have you ever avoided eating seafood because of Pfiesteria outbreaks?

1 Yes
2 No
3 DK/NA

**Q: REDUCE**

Would a Pfiesteria outbreak in [STATE] next week reduce the NUMBER of seafood meals you would eat next month?

1 Yes
2 No
3 DK/NA

**Q: SWIM**

For the following questions, please tell me if you strongly agree, agree, disagree, or strongly disagree with the following statements. It is safe to swim in coastal waters during a Pfiesteria outbreak.

1 Strongly agree
2 Agree
3 Disagree
4 Strongly disagree
5 Uncertain
6 NA

**Q: BREATHE**

It is safe to breathe the air around coastal waters during a Pfiesteria outbreak.

1 Strongly agree
2 Agree
3 Disagree
4 Strongly disagree
5 Uncertain
6 NA

**Q: EAT**

It is safe to eat seafood from an area where a Pfiesteria outbreak has happened.

1 Strongly agree
2 Agree
3 Disagree
4 Strongly disagree
5 Uncertain

6 NA

**Q: FARMS**

Pollution from farms can cause Pfiesteria outbreaks.

1 Strongly agree
2 Agree
3 Disagree
4 Strongly disagree
5 Uncertain
6 NA

**Q: FACTORY**

Pollution from factories can cause Pfiesteria outbreaks.

1 Strongly agree
2 Agree
3 Disagree
4 Strongly disagree
5 Uncertain
6 NA

**Q: STATE**

Now I'd like to ask you some questions about yourself. How long have you lived in [STATE]? (IN YEARS)

**Q: COUNTY**

What county do you live in?

**Q: LENGTH**

How long have you lived in [COUNTY] County (in years)?

INTERVIEWER: IF LESS THAN 1 YEAR, ENTER 1.

**Q: ZIPCODE**

What is your zip code?

**Q: HOUSE**

Including yourself, how many people normally live in your household?

IF (ANSWER = 1) SKIP TO SEX

**Q: CHILDREN**

How many are under the age of 18?

**Q: SEX**

Are you male or female?

1 Male
2 Female
3 DK/NA

**Q: RACE**

What is your race or ethnic background?

1 White
2 Black
3 Other
4 DK/NA

**Q: BORN**

In what year were you born?

INTERVIEWER: ENTER LAST TWO DIGITS ONLY

19___

**Q: EDUC**

What is the highest level or grade you completed in school?

INTERVIEWER: ENTER NUMBER ONLY. IF COMPLETED HIGH SCHOOL, ENTER "12"
FOR COLLEGE, ENTER "16". FOR GRAD SCHOOL, ENTER "18". FOR DOCTORATE, ENTER "20".

**Q: INCOME**

As close as you can recall, how much income did your household earn last year? Was it above or below $40,000?

1 Above
2 Below
3 About $40,000
4 REFUSED
5 DK/NA

IF (ANSWER = 2) SKIP TO INCOMEE
if (state2 = 1 | state2 = 2) TEMP = RAND  (1 4)
IF (TEMP < 4) BROCHURE = TEMP
IF (TEMP = 4) BROCHURE = 6
if (state2 = 3 | state2 = 4) BROCHURE = RAND  (7 12)
if (answer = 3) skip to PARTIC
if (answer = 4) skip to PARTIC

**Q: INCOMEB**

Was it above $50,000?

1 Yes
2 No
3 DK/NA

if (state2 = 1 | state2 = 2) TEMP = RAND  (1 4)
IF (TEMP < 4) BROCHURE = TEMP
IF (TEMP = 4) BROCHURE = 6
if (state2 = 3 | state2 = 4) BROCHURE = RAND  (7 12)
IF (ANSWER = 2) SKIP TO PARTIC

**Q: INCOMEC**

Was it above $75,000?

1 Yes
2 No
3 DK/NA

if (state2 = 1 | state2 = 2) TEMP = RAND  (1 4)
IF (TEMP < 4) BROCHURE = TEMP
IF (TEMP = 4) BROCHURE = 6
if (state2 = 3 | state2 = 4) BROCHURE = RAND  (7 12)
IF (ANSWER = 2) SKIP TO PARTIC

**Q: INCOMED**

Was it above $100,000?

1 Yes
2 No
3 DK/NA

if (state2 = 1 | state2 = 2) TEMP = RAND (1 4)
IF (TEMP < 4) BROCHURE = TEMP
IF (TEMP = 4) BROCHURE = 6
if (state2 = 3 | state2 = 4) BROCHURE = RAND (7 12)
IF (ANSWER = 1) SKIP TO PARTIC
IF (ANSWER = 2) SKIP TO PARTIC

**Q: INCOMEE**

Was it above $30,000?

1 Yes
2 No
3 DK/NA

if (state2 = 1 | state2 = 2) TEMP = RAND (1 4)
IF (TEMP < 4) BROCHURE = TEMP
IF (TEMP = 4) BROCHURE = 6
if (state2 = 3 | state2 = 4) BROCHURE = RAND (7 12)
IF (ANSWER = 1) SKIP TO PARTIC

**Q: INCOMEF**

Was it above $20,000?

1 Yes
2 No
3 DK/NA

if (state2 = 1 | state2 = 2) TEMP = RAND (1 4)
IF (TEMP < 4) BROCHURE = TEMP
IF (TEMP = 4) BROCHURE = 6
if (state2 = 3 | state2 = 4) BROCHURE = RAND (7 12)
IF (ANSWER = 1) SKIP TO PARTIC

**Q: INCOMEG**

Was it above $10,000?

1 Yes
2 No
3 DK/NA

if (state2 = 1 | state2 = 2) TEMP = RAND  (1 4)
IF (TEMP < 4) BROCHURE = TEMP
IF (TEMP = 4) BROCHURE = 6
if (state2 = 3 | state2 = 4) BROCHURE = RAND  (7 12)

**Q: PARTIC**

Based on your answers to these questions we would like for you to participate in a short follow up survey in about a month. The survey is about Pfiesteria and seafood safety. The questions only take about five minutes. Would you be willing to participate in this follow up survey?

1 Yes
2 No

if (answer = 1) skip to INFO

**Q: REASON**

What is the main reason you don't want to participate in the follow up survey?

INTERVIEWER: CHECK ALL THAT APPLY

1 I don't have enough time
2 I don't like these questions/survey
3 I think you're trying to sell me something
4 I'm moving soon
5 I don't want to eat seafood anymore
6 Not interested
7 Other
8 DK/NA

SKIP TO INTERID

**Q: INFO**

Thanks! In about a week, we'll send you some information about Pfiesteria and seafood safety in the mail. In about a month, we'll call you back and ask for your opinions about that information. So that we can send you this information, what is your name and mailing address?

**Q: INTERID**

Well, that's all my questions at this time. Thanks so much for taking the time to answer my questions. Have a super day!

**Q: THANKS1**

Thanks anyway, but we need to speak to people who eat seafood. Have a good day!
INTERVIEWER: ENTER 1 TO CONTINUE

**Q: THANKS**

Thank you for your time, but we need to speak to people who typically eat seafood in a month. Have a good day!

## Appendix C. Mail-out Information

Cover Letter

Date

Name
Address

Dear Name:

About one or two weeks ago you spoke with an interviewer from the East Carolina University Survey Research Laboratory regarding a survey on behalf of the National Oceanic and Atmospheric Administration and the U.S. Environmental Protection Agency. Researchers at East Carolina University, Ohio State University, University of Delaware, University of Maryland, and the Virginia Institute of Marine Sciences are participating. The purpose of this study is to better understand seafood consumption patterns and to get your opinions about seafood safety. These issues are important to the economy of the Mid-Atlantic Region.

During your phone conversation you agreed to participate in a follow up survey. First of all, thank you for agreeing to participate! Second, enclosed is the information about Pfiesteria and seafood safety that we promised to send you. Please carefully consider the information. In about two weeks we will call you back and ask for your opinions about this information. The second telephone interview is shorter than the first and will take only about 5 or 10 minutes.

Finally, thank you again for participating in our survey! If you have any questions about the survey or the information we sent you please do not hesitate to call me at (252)328-6006 or e-mail me at WhiteheadJ@mail.ecu.edu. Also, if we have contacted you by mistake, please let us know so that we can take you off our mailing list.

Sincerely,

John Whitehead
Associate Professor of Economics

## Pfiesteria Brochure Text[1]

What You Should Know About Pfiesteria

This booklet provides information about some issues related to Pfiesteria. This booklet and our telephone interview with you will consider these issues because they are important to the economy of the Mid-Atlantic Region. Please carefully consider the information in this booklet before our telephone interview. You may also like to have it nearby during our telephone interview.

What is Pfiesteria?

Pfiesteria (fis-teer-ee-ah) is a potentially toxic organism that has been associated with fish kills in coastal waters from Delaware to North Carolina. A fish kill is a situation in which many fish -- more than a few dozen -- die within hours or days.

Discovered in 1988, Pfiesteria has a 24 stage life-cycle. A few of these stages can produce toxins that affect fish. Pfiesteria is microscopic algae that is a natural part of the environment.

How does Pfiesteria affect fish?

Pfiesteria usually is in its non-toxic form, feeding on algae and bacteria in coastal rivers. Scientists believe that Pfiesteria only becomes toxic in the presence of a large number of fish. Pfiesteria cells then change form and stun the fish with a powerful toxin. The toxins are believed to cause lesions or sores.

Pfiesteria is NOT an infection like bacteria or viruses. Fish are NOT killed by an infection of Pfiesteria. Fish are killed by the toxins Pfiesteria releases, or by other infections once the Pfiesteria toxins have caused sores to develop. Fish may also die from Pfiesteria toxins without developing sores.

How long do toxic Pfiesteria outbreaks last?

Toxic outbreaks of Pfiesteria are typically very short, no more than a few hours. After an outbreak, Pfiesteria cells change back into non-toxic forms very quickly, and the Pfiesteria toxins in the water go away within a few hours. However, Pfiesteria-associated fish sores or fish kills may continue for days or even weeks.

Is Pfiesteria the only cause of fish sores and fish kills?

[1] See http://www.csb.uncw.edu/people/whiteheadj/research/ecohab/survey.htm for copies of the actual brochure and inserts as *.pdf files. Hard copies of the brochure and inserts are available upon request.

Pfiesteria is only one cause of fish kills. Other causes include a lack of dissolved oxygen in the water, changes in water salinity or temperature, sewage or chemical spills, red or brown tides, infections, and other environmental changes.

In addition, there are many possible causes for fish sores other than Pfiesteria. These include physical injury in nets or traps, bites by other fish or birds, poor water quality, and viruses or bacteria.

Where has Pfiesteria been found?

Pfiesteria has been found in coastal waters from Delaware Bay to North Carolina. It has not been found in freshwater lakes, streams, or other inland waters.

Pfiesteria has been associated with major fish kills at many sites along the North Carolina coast, particularly the New, Neuse and Tar-Pamlico Rivers. Pfiesteria has been associated with fish kills in the Chicamacomico and Manokin Rivers and King's Creek in Maryland, and the lower Pocomoke River in Maryland and Virginia. Pfiesteria has been associated with fish sores in Maryland, Virginia, and North Carolina.

What causes toxic Pfiesteria outbreaks?

Scientists generally agree that a large number of fish can make Pfiesteria become toxic. However, other factors may contribute to toxic Pfiesteria outbreaks. Pollutants are thought to help Pfiesteria grow by stimulating the growth of algae that Pfiesteria feeds on. Excess nutrients such as nitrogen and phosphorus are common pollutants in coastal waters. The main sources of nutrient pollution in coastal areas are sewage treatment plants, septic tanks, runoff from cities, suburbs and farms, and air pollutants that settle on the land and water.

Can Pfiesteria cause human health problems?

Any human health problems associated with Pfiesteria are from its release of toxins into coastal waters. Preliminary evidence suggests that exposure to waters where toxic forms of Pfiesteria are active may cause memory loss, confusion, and a variety of other symptoms including respiratory, skin, and gastrointestinal problems. It has been shown that similar human health effects can be caused by exposure to Pfiesteria toxins in laboratories.

Pfiesteria is not a virus, fungus, or bacteria. It is not contagious or infectious, and cannot be "caught" like a cold or flu. There is no evidence that Pfiesteria-associated illnesses are associated with eating finfish or shellfish.

Is Pfiesteria related to red and brown tides?

A few species of algae can become harmful to marine life and to people under certain conditions. Scientists call such events "harmful algal blooms." Brown tides, toxic

Pfiesteria outbreaks, and some kinds of red tides are all types of harmful algal blooms.

Who should I contact to report fish sores or fish kills?

A few fish with sores or even a few dead fish are not cause for alarm. However, if you notice a lot of fish -- more than a few dozen -- that are dead or dying, have sores, or showing other signs of disease, please contact your state's Pfiesteria hotlines:

| | |
|---|---|
| Delaware | 1-800-523-3336 |
| Maryland | 1-888-584-3110 |
| North Carolina | 1-888-823-6915 |
| Virginia | 1-888-238-6154 |

Counter Information Insert

Is it safe to eat seafood?

YES. In general, it IS safe to eat seafood.

There has never been a case of illness from eating finfish or shellfish exposed to Pfiesteria. There is no evidence of Pfiesteria-contaminated finfish or shellfish on the market. There is no evidence that illnesses related to Pfiesteria are associated with eating finfish or shellfish.

The following common-sense precautions are recommended:

- Obey public health advisories.
- Do not harvest or consume fish or shellfish from areas that are closed by the state.
- Do not handle or consume finfish or shellfish that you have caught that are already dead or dying; that have sores, or other signs of disease.

Is it safe to swim and boat in coastal waters?

YES. In general, swimming, boating, and other recreational activities in coastal waters ARE generally safe. The following common-sense precautions are recommended:

Obey public health advisories. Do not go into or near the water in areas that are closed by the state.

If you notice significant numbers of fish that are dead or that have sores, avoid contact with the fish and water, and report the incident to your state's environment or natural resource agency.

If you have health problems after being exposed to fish, water, or air at the site of a fish kill or suspected toxic Pfiesteria outbreak, contact your physician and your state or local public health agency right away.

What is being done about Pfiesteria?

State and federal agencies are working closely with local governments and academic institutions to address the problems posed by Pfiesteria. Federal agencies involved in the effort include the:

U.S. Environmental Protection Agency
National Oceanic and Atmospheric Administration
Centers for Disease Control and Prevention
National Institute of Environmental Health Sciences
Food and Drug Administration
U.S. Geological Survey, and

U.S. Department of Agriculture.

Together with state departments of health and natural resources, these agencies are working to:

- manage the risk of human health effects by monitoring and rapid response through river closures and public health advisories
- direct funding and technical expertise to Pfiesteria-related research and monitoring
- make current and accurate information widely available to the public, and
- understand and address the causes of Pfiesteria outbreaks.

Fish Kill Information Insert

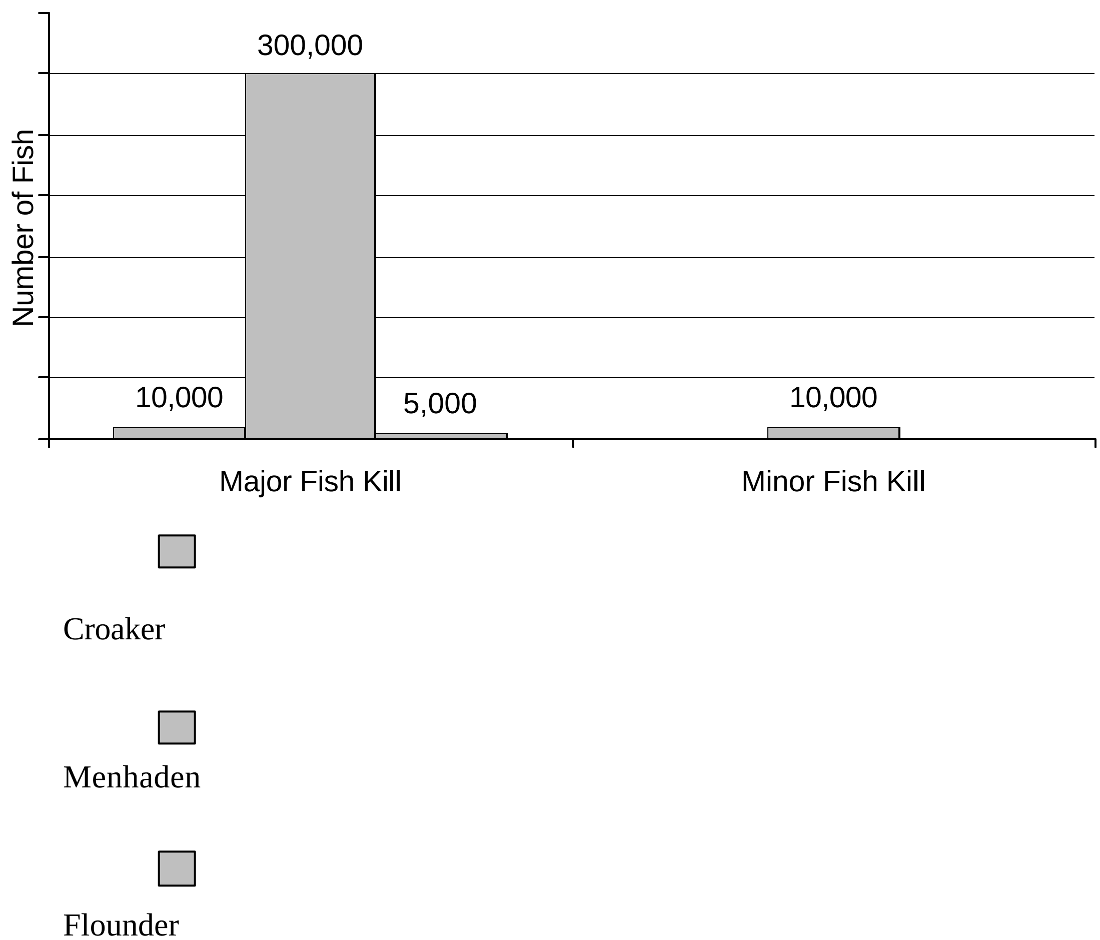
Pfiesteria Associated Fish Kills in the Mid-Atlantic Region

The following describes what some people consider to be typical Pfiesteria associated fish kills in the Mid-Atantic Region

Major Pfiesteria associated fish kills typically involve hundreds of thousands of fish over large areas of river surface. Most of the fish in these kills are menhaden. However edible species such as croaker and flounder may also be found. Lesions appear on more than 50% of the menhaden.

Minor Pfiesteria associated fish kills typically involve less than ten thousand fish over small areas of river surface. All of the fish in these kills tend to be menhaden. Lesions appear on more than 50% of the menhaden.

For example, this chart illustrates typical major and minor fish kills



## Seafood Inspection Program Insert

Seafood Inspection Program of the U.S. Department of Commerce

The U.S. Department of Commerce (USDC), National Oceanic and Atmospheric Administration (NOAA) offers a voluntary inspection service to seafood producers and processors (under the authority of the Agricultural Marketing Act of 1946). The Voluntary Seafood Inspection Program offers a variety of professional inspection services that assure compliance with all applicable food regulations.

USDC Seafood Inspection Program services are provided for a fee. As of October 1, 1999, the basic hourly fee for a full-time in-house plant inspector was $49.30. Services provided by the USDC seafood inspectors are designed to meet the needs of the individual producers. Generally, the inspector serves as:

- Sanitation advisor: oversees corrections of sanitary practices at the facility
- Quality control monitor: observes production to assure a wholesome end product
- Official certifier: sample and evaluates final product for U.S. Grade A certification

Products inspected and certified under the USDC Seafood Inspection Program that meet all of the requirements and criteria specified have the U.S. Grade A seal of approval.

The U.S. Grade A mark signifies that a product meets the highest level of quality established in the applicable U.S. grade standard and has been processed under the USDC Voluntary Seafood Inspection Program in a sanitarily approved facility.

A Proposed Mandatory Inspection Program

Only a small number of seafood producers participate in the voluntary seafood inspection program. The main reason is that some businesses think the voluntary seafood inspection program will result in higher prices. It has been proposed that the voluntary seafood inspection program become mandatory.

Seafood producers would be required to pay the fee for a USDC seafood inspector. With the Mandatory Seafood Inspection Program you could be sure that all the seafood you ate had the Grade A seal of approval.

Hypothetical Fish Kill Insert: Version A

A Hypothetical Situation

Please consider the following hypothetical situation. This press release is based on fish kills that have actually happened in the past. But remember, the fish kill that is described did not actually take place. Look on the back of this page for the location of the hypothetical fish kill. When we call you back, we'll talk about this hypothetical situation.

Press Release
September 2000

Last week, scientists responded to reports of dead fish on the lower Pocomoke River. Dead fish were observed over a large area of the main portion of the river between Shelltown and Fair Island. The kill was estimated to affect approximately 300,000 menhaden, 10,000 croaker and 5,000 flounder. Lesions were observed on over 75% of the menhaden. The fish had been dead for at least 24 hours. Other fish in the area were healthy, suggesting conditions that caused the kill had ceased.

Water samples were collected and sent to several laboratories for Pfiesteria analysis. All results to date indicate that Pfiesteria was involved in the fish kill. According to a university scientist, two samples showed concentrations of the organism at levels high enough to be lethal to fish under certain environmental conditions if the organisms are actively releasing toxins.

As a precaution, until the cause of the fish kill can be determined, it is recommended that you avoid direct body contact with the water in the fish kill area; including swimming, water skiing, personal watercraft operation, fishing, clamming, crabbing or other recreational water activities. If you fall into the water, change any wet clothing and wash with soap and clean water. Keep pets from affected areas. Avoid touching any sores or lesions on the dead or dying fish and do not eat dead or dying fish or fish with sores. If you experience any illness that you think could be related to the fish kill, contact your physician promptly.

State officials are working to monitor the situation and collect additional information as needed.

# Hypothetical Fish Kill Insert: Version B

A Hypothetical Situation

Please consider the following hypothetical situation. This press release is based on fish kills that have actually happened in the past. But remember, the fish kill that is described did not actually take place. Look on the back of this page for the location of the hypothetical fish kill. When we call you back, we'll talk about this hypothetical situation.

Press Release
September 2000

Last week, scientists responded to reports of dead fish on the lower Pocomoke River. Dead fish were observed over a small area in the main portion of the river between Shelltown and Fair Island. The kill was estimated to affect approximately 10,000 menhaden. Lesions were observed on over 50% of the fish. The fish had been dead for at least 24 hours. Other fish in the area were healthy, suggesting conditions that caused the kill had ceased.

Water samples were collected and sent to several laboratories for Pfiesteria analysis. All results to date indicate that Pfiesteria was involved in the fish kill. According to a university scientist, two samples showed concentrations of the organism at levels high enough to be lethal to fish under certain environmental conditions if the organisms are actively releasing toxins.

As a precaution, until the cause of the fish kill can be determined, it is recommended that you avoid direct body contact with the water in the fish kill area; including swimming, water skiing, personal watercraft operation, fishing, clamming, crabbing or other recreational water activities. If you fall into the water, change any wet clothing and wash with soap and clean water. Keep pets from affected areas. Avoid touching any sores or lesions on the dead or dying fish and do not eat dead or dying fish or fish with sores. If you experience any illness that you think could be related to the fish kill, contact your physician promptly.

State officials are working to monitor the situation and collect additional information as needed.

Hypothetical Fish Kill Insert: Version C

A Hypothetical Situation

Please consider the following hypothetical situation. This press release is based on fish kills that have actually happened in the past. But remember, the fish kill that is described did not actually take place. Look on the back of this page for the location of the hypothetical fish kill. When we call you back, we'll talk about this hypothetical situation.

Press Release
September 2000

Last week, scientists responded to reports of dead fish on the lower Neuse River. Dead fish were observed over a large area in the main portion of the river between New Bern and Slocum Creek. The kill was estimated to affect approximately 300,000 menhaden, 10,000 croaker and 5,000 flounder. Lesions were observed on over 75% of the menhaden. The fish had been dead for at least 24 hours. Other fish in the area were healthy, suggesting conditions that caused the kill had ceased.

Water samples were collected and sent to several laboratories for Pfiesteria analysis. All results to date indicate that Pfiesteria was involved in the fish kill. According to a university scientist, two samples showed concentrations of the organism at levels high enough to be lethal to fish under certain environmental conditions if the organisms are actively releasing toxins.

As a precaution, until the cause of the fish kill can be determined, it is recommended that you avoid direct body contact with the water in the fish kill area; including swimming, water skiing, personal watercraft operation, fishing, clamming, crabbing or other recreational water activities. If you fall into the water, change any wet clothing and wash with soap and clean water. Keep pets from affected areas. Avoid touching any sores or lesions on the dead or dying fish and do not eat dead or dying fish or fish with sores. If you experience any illness that you think could be related to the fish kill, contact your physician promptly.

State officials are working to monitor the situation and collect additional information as needed.

Hypothetical Fish Kill Insert: Version D

A Hypothetical Situation

Please consider the following hypothetical situation. This press release is based on fish kills that have actually happened in the past. But remember, the fish kill that is described did not actually take place. Look on the back of this page for the location of the hypothetical fish kill. When we call you back, we'll talk about this hypothetical situation.

Press Release
September 2000

Last week, scientists responded to reports of dead fish on the lower Neuse River. Dead fish were observed over a small area in the main portion of the river between New Bern and Slocum Creek. The kill was estimated to affect approximately 10,000 menhaden. Lesions were observed on over 50% of the fish. The fish had been dead for at least 24 hours. Other fish in the area were healthy, suggesting conditions that caused the kill had ceased.

Water samples were collected and sent to several laboratories for Pfiesteria analysis. All results to date indicate that Pfiesteria was involved in the fish kill. According to a university scientist, two samples showed concentrations of the organism at levels high enough to be lethal to fish under certain environmental conditions if the organisms are actively releasing toxins.

As a precaution, until the cause of the fish kill can be determined, it is recommended that you avoid direct body contact with the water in the fish kill area; including swimming, water skiing, personal watercraft operation, fishing, clamming, crabbing or other recreational water activities. If you fall into the water, change any wet clothing and wash with soap and clean water. Keep pets from affected areas. Avoid touching any sores or lesions on the dead or dying fish and do not eat dead or dying fish or fish with sores. If you experience any illness that you think could be related to the fish kill, contact your physician promptly.

State officials are working to monitor the situation and collect additional information as needed.

## Appendix D. Second Telephone Survey Instrument

Q: INTRO

Hello, my name is ______, and I'm calling from the East Carolina University Survey Research Laboratory. We recently spoke to [NAME] who completed a seafood survey, and we're calling back to complete a follow-up. May I please speak to [NAME]?

Q: INFOR

About one month ago you talked to someone from the ECU Survey Research Lab about seafood safety. We also mailed you some information about seafood and fish kills. Did you get the information we sent to you?

1 Yes
2 No
3 DK/NA

if (answer = 2) skipto MAIL
if (answer = 3) skipto MAIL

Q: READ

Have you had a chance to read the information yet?

1 Yes
2 No
3 DK/NA

IF (ANSWER = 2) SKIPTO CALLBACK
IF (ANSWER = 3) SKIPTO CALLBACK

Q: AMOUNT

When you read it, did you read...[READ CATEGORIES]?

1 All of it
2 Just some of it
3 DK/NA

Q: CLOSELY

Did you read it...[READ CATEGORIES]?

1 Very closely
2 Somewhat closely

3 Not very closely
4 Or not closely at all
5 DK/NA

Q: INFOWITH

Do you have the information with you now?

INTERVIEWER: IF THEY SAY NO, TELL THEM THEY DON'T NEED IT IN FRONT OF THEM TO DO THE SURVEY

1 Yes
2 No
3 DK/NA

Q: OFTEN2

This set of questions deal with how often you eat seafood. Please think about the seafood meals that you eat at home and at restaurants. Think about finfish, like flounder, and shellfish, like oysters, but don't include canned seafood like canned tuna.

INTERVIEWER: FROZEN SEAFOOD, LIKE FISHSTICKS OR TV DINNERS ARE OKAY!

Do you eat seafood ... ?

1 About once or twice a year?
2 About once or twice a month?
3 About once a week?
4 More than once a week?

Q: WEEK2

For the next several questions, consider the seafood that you recently ate, other than canned seafood. Only include meals you ate at home and at restaurants. About how many seafood meals did you eat most recently, or within the last week?

Q: MONTH2

About how many seafood meals did you eat last month?

(IF ASKED, INCLUDING THE MEALS FROM LAST WEEK)

IF (MONTH2 >= 0) NUMBER = MONTH2
if (answer >= 0) skipto TYPICAL2

Q: LSTMONT2

Did you eat about [MONTHA2] seafood meals last month?

1 Yes
2 No
3 DK/NA

montha2 = 4 × WEEK2
IF (LSTMONT2 = 1) NUMBER = montha2
IF (ANSWER = 1) SKIPTO TYPICAL2

Q: MORLESS2

Did you eat more or less?

1 More
2 Less
3 DK/NA

if (morless2 = 3) NUMBER = montha2
IF (ANSWER = 1) SKIPTO MORE2
if (answer = 3) skipto typical2

Q: LESS2

About how many less?

IF (LESS2 >= 0) NUMBER = (MONTHA2 - LESS2)
if (morless2 = 3) NUMBER = montha2
SKIPTO TYPICAL2

Q: MORE2

About how many more?

IF (MORE2 >= 0) NUMBER = (MORE2 + MONTHA2)

Q: TYPICAL2

Do you typically eat [NUMBER] seafood meals every month?

1 Yes
2 No
3 DK/NA

If (answer = 2) skipto TYPMONT2
If (answer = 3) skipto TYPMONT2

Q: TYPMONT2

About how many seafood meals do you typically eat every month?

Q: NXTMONT2

Thinking about the seafood meals you ate last month again, if the average price of your seafood meals stay the same, do you think you will eat more, less, or the same number of seafood meals next month?

1 More
2 Less
3 Same
4 DK/NA

if (answer = 3) skipto UNDRPFST
IF (ANSWER = 4) SKIPTO UNDRPFST

Q: EATMONT2

About how many [more/less] seafood meals do you think you will eat next month?

Q: UNDRPFST

The next few questions are about Pfiesteria [pronounced fis-teer-e-ah]. In terms of understanding Pfiesteria, did you find the information we sent you.... [READ CATEGORIES]?

1 Very helpful
2 Somewhat helpful
3 Not very helpful
4 Or not helpful at all
5 DK/NA

Q: NEWS1

Have you heard or read anything else about Pfiesteria since the first survey?

1 Yes
2 No
3 DK/NA

If (answer = 2) Skipto PFIEST2

If (answer = 3) Skipto PFIEST2

Q: NEWS2

Did you read about it in the newspapers, hear about it on television or something else?

1 Newspaper
2 Television
3 Something else
4 DK/NA

Q: PFIEST2

To the best of your knowledge, would you say that Pfiesteria {pronounced fis-teer-ee-ah} is...

1 A form of pollution
2 A disease in fish
3 A toxic organism
4 A predator that attacks fish
5 A parasite in fish
6 DK/NA

Q: OUTBREA2

Pfiesteria is a potentially toxic organism that has been associated with fish kills in coastal waters from Delaware to North Carolina. To the best of your knowledge, have outbreaks of Pfiesteria {pronounced fis-teer-ee-ah} occurred in [STATE] during the past month?

1 Yes
2 No
3 DK/NA

Q: CONCERN2

How concerned are you about Pfiesteria {pronounced fis-teer-ee-ah}?

1 Very concerned
2 Somewhat concerned
3 Not concerned
4 DK/NA

Q: AVOID2

Have you ever avoided eating seafood because of Pfiesteria outbreaks?

1 Yes
2 No
3 DK/NA

Q: REDUCE2

Would a Pfiesteria outbreak in [STATE] next week reduce the number of seafood meals you would eat next month?

1 Yes
2 No
3 DK/NA

Q: SWIM2

For the following questions, please tell me if you strongly agree, agree, disagree, or strongly disagree with the following statements. It is safe to swim in coastal waters during a Pfiesteria outbreak.

1 Strongly agree
2 Agree
3 Disagree
4 Strongly disagree
5 Uncertain
6 NA

Q: BREATHE2

It is safe to breathe the air around coastal waters during a Pfiesteria outbreak.

1 Strongly agree
2 Agree
3 Disagree
4 Strongly disagree
5 Uncertain
6 NA

Q: EAT2

It is safe to eat seafood from an area where a Pfiesteria outbreak has happened.

1 Strongly agree
2 Agree
3 Disagree
4 Strongly disagree
5 Uncertain

6 NA

Q: FARMS2

Pollution from farms can cause Pfiesteria outbreaks.

1 Strongly agree
2 Agree
3 Disagree
4 Strongly disagree
5 Uncertain
6 NA

Q: FACTORY2

Pollution from factories can cause Pfiesteria outbreaks.

1 Strongly agree
2 Agree
3 Disagree
4 Strongly disagree
5 Uncertain
6 NA

IF (BROCHURE = 2) SKIPTO BROC2
IF (BROCHURE = 4) SKIPTO BROC2
IF (BROCHURE = 6) SKIPTO BROC2
IF (BROCHURE = 7) SKIPTO BROC3
IF (BROCHURE = 9) SKIPTO BROC3
IF (BROCHURE = 11) SKIPTO BROC3
IF (BROCHURE = 8) SKIPTO BROC4
IF (BROCHURE = 10) SKIPTO BROC4
IF (BROCHURE = 12) SKIPTO BROC4

Q: BROC1

Now think about the hypothetical fish kill information that we sent you. The Pfiesteria-associated fish kill affected about 10,000 menhaden over a small portion of the Pokomoke River. Lesions were observed on over 50% of the menhaden. Do you think this hypothetical fish kill is...[READ CATEGORIES]?

1 Very realistic
2 Somewhat realistic
3 Not very realistic
4 Or not realistic at all
5 DK/NA

SKIPTO FISHKILL

Q: BROC2

Now think about the hypothetical fish kill information that we sent you. The Pfiesteria-associated fish kill affected about 300,000 menhaden, 10,000 croaker, and 5,000 flounder over a large portion of the Pokomoke River. Lesions were observed on over 75% of the menhaden. Do you think this hypothetical fish kill is... [READ CATEGORIES]?

1 Very realistic
2 Somewhat realistic
3 Not very realistic
4 Or not realistic at all
5 DK/NA

SKIPTO FISHKILL

Q: BROC3

Now think about the hypothetical fish kill information that we sent you. The Pfiesteria-associated fish kill affected about 10,000 menhaden over a small portion of the Neuse River. Lesions were observed on over 50% of the menhaden. Do you think this hypothetical fish kill is... [READ CATEGORIES]?

1 Very realistic
2 Somewhat realistic
3 Not very realistic
4 Or not realistic at all
5 DK/NA

SKIPTO FISHKILL

Q: BROC4

Now think about the hypothetical fish kill information that we sent you. The Pfiesteria-associated fish kill affected about 300,000 menhaden, 10,000 croaker and 5,000 flounder over a large portion of the Neuse River. Lesions were observed on over 75% of the menhaden. Do you think this hypothetical fish kill is...[READ CATEGORIES]?

1 Very realistic
2 Somewhat realistic
3 Not very realistic
4 Or not realistic at all
5 DK/NA

Q: FISHKILL

In your opinion, do you think this is a major or minor fish kill?

1 Major
2 Minor
3 DK/NA

IF (BROCHURE = 7) SKIPTO NEUSE
IF (BROCHURE = 9) SKIPTO NEUSE
IF (BROCHURE = 11) SKIPTO NEUSE
IF (BROCHURE = 8) SKIPTO NEUSE
IF (BROCHURE = 10) SKIPTO NEUSE
IF (BROCHURE = 12) SKIPTO NEUSE

Q: POKOMOKE

Do you ever eat seafood caught from the Pokomoke River?

1 Yes
2 No
3 DK/NA

SKIPTO MARYLAN

Q: NEUSE

Do you ever eat seafood caught from the Neuse River?

1 Yes
2 No
3 DK/NA

SKIPTO NORTHCA

Q: MARYLAN

Do you ever eat seafood caught from Maryland?

1 Yes
2 No
3 DK/NA

SKIPTO MARYLAND

Q: NORTHCA

Do you ever eat seafood caught from North Carolina?

1 Yes
2 No
3 DK/NA

SKIPTO NORTHCAR

Q: MARYLAND

Now imagine that this fish kill really happened last week. Would this make you think that seafood from the Pokomoke River was not safe to eat?

1 Yes
2 No
3 DK/NA

SKIPTO CHANCE2

Q: NORTHCAR

Now imagine that this fish kill really happened last week. Would this make you think that seafood from the Neuse River was not safe to eat?

1 Yes
2 No
3 DK/NA

Q: CHANCE2

After the fish kill, consider the seafood meals you expect to eat next month. What do you think are your chances of getting sick from eating these meals? Do you think they are … ?

1 Very likely
2 Somewhat likely
3 Somewhat not likely
4 Not likely at all
5 DK/NA

Q: PERCENT2

Do you think your chances are greater or less than 1%?

1 Greater

2 Less
3 About 1%
4 DK/NA

if (answer = 1) skipto eatafter
if (answer = 3) skipto eatafter
if (answer = 4) skipto eatafter CHANSICK = RANDNUM (1 4)
IF (CHANSICK = 2) SKIPTO CHAN2B
IF (CHANSICK = 3) SKIPTO CHAN3B
IF (CHANSICK = 4) SKIPTO CHAN4B

Q: CHAN1b

This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in 1,000?

1 Greater than
2 Less than
3 About that
4 DK/NA

SKIPTO eatafter

Q: CHAN2b

This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in 10,000?

1 Greater than
2 Less than
3 About that
4 DK/NA

SKIPTO eatafter

Q: CHAN3b

This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in 100,000?

1 Greater than
2 Less than
3 About that

4 DK/NA

SKIPTO eatafter

Q: CHAN4b

This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in 1,000,000?

1 Greater than
2 Less than
3 About that
4 DK/NA

Q: EATAFTER

Thinking about seafood meals again, suppose that the average price of your seafood meals stay the same. Compared to the [NUMBER] meals you ate last month, do you think you would eat more, less, or the same number next month after the fish kill?

1 More
2 Less
3 Same
4 DK/NA

if (answer = 3) skipto habits
if (answer = 4) skipto habits

Q: AFTER

About how many [more/less] seafood meals do you think you would eat next month after the fish kill?

Q: HABITS

Would anything else about your eating habits change?

1 Yes
2 No
3 DK/NA

IF (ANSWER = 2) SKIPTO INSPECT
IF (ANSWER = 3) SKIPTO INSPECT

Q: CHANGE

What else would change? INTERVIEWER: CHECK ALL THAT APPLY

1 I'd eat more restaurant meals
2 I'd eat fewer restaurant meals
3 I'd go fishing more
4 I'd go fishing less
5 I'd cook at home more
6 I'd cook at home less
7 I'd eat more poultry
8 I'd eat more meat
9 I'd eat more vegetables
10 I'd eat more beans
11 I'd eat more eggs
12 I'd eat more canned seafood
13 I would not eat croaker
14 I would not eat flounder
15 Other
16 DK/NA
17 No more/finished

Q: INSPECT

We also sent you some information about the U.S Department of Commerce's voluntary seafood inspection program. Do you think the information that we sent you is...[READ CATEGORIES]?

1 Very clear
2 Somewhat clear
3 Not very clear
4 Or not clear at all
5 DK/NA

Q: PROGRAM

It has been proposed that the Department of Commerce should make the voluntary seafood program a mandatory program. All seafood businesses in the country would have to participate as described in the information we sent you. With the mandatory seafood inspection program you could be sure that all the seafood you ate from restaurants, grocery stores, and fresh seafood markets had the Grade A seal of approval.

Q: CHANCE3

After the fish kill and with the mandatory seafood inspection program, consider the seafood meals you expect to eat next month. What do you think are your chances of getting sick from eating these meals? Do you think they are … ?

1 Very likely
2 Somewhat likely
3 Somewhat not likely
4 Not likely at all
5 DK/NA

Q: PERCENT3

Do you think your chances are greater or less than 1%?

1 Greater
2 Less
3 About 1%
4 DK/NA

if (answer = 1) skipto aftprog
if (answer = 3) skipto aftprog
if (answer = 4) skipto aftprog
IF (CHANSIC = 2) SKIPTO CHAN2C
IF (CHANSIC = 3) SKIPTO CHAN3C
IF (CHANSIC = 4) SKIPTO CHAN4C

Q: CHAN1c

This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in 1,000?

1 Greater than
2 Less than
3 About that
4 DK/NA

SKIPTO aftprog

Q: CHAN2c

This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in 10,000?

1 Greater than
2 Less than
3 About that
4 DK/NA

SKIPTO aftprog

Q: CHAN3c

This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in 100,000?

1 Greater than
2 Less than
3 About that
4 DK/NA

SKIPTO aftprog

Q: CHAN4c

This means that you think your chance of getting sick is less than one in 100. We'd like to know how low you think your chances are. Do you think your chances of getting sick are greater or less than 1 in 1,000,000?

1 Greater than
2 Less than
3 About that
4 DK/NA

Q: AFTPROG

Now suppose the average price of your seafood meals stay the same. Compared to the [NUMBER] meals you ate last month, do you think you would eat more, less, or the same number next month after the fish kill and with the mandatory seafood inspection program.

1 More
2 Less
3 Same
4 DK/NA

IF (ANSWER = 3) SKIPTO HIGHER
IF (ANSWER = 4) SKIPTO HIGHER

Q: MANY

About how many more/less seafood meals do you think you would eat next month?

Q: HIGHER

Only a small number of seafood producers participate in the voluntary seafood inspection program. The main reason is that some businesses think the program will result in higher prices. Do you think the seafood inspection program would make seafood prices higher?

1 Yes
2 No
3 DK/NA

IF (AFTFISH = 2) SKIPTO AFTFISH2
IF (AFTFISH = 3) SKIPTO AFTFISH3
IF (AFTFISH = 4) SKIPTO AFTFISH4

Q: AFTFISH1

Suppose that with the mandatory seafood inspection program the price of your portion of your average seafood meals goes up by $1, but the price of all other food stays the same. Compared to the [NUMBER] meals you ate last month, do you think that you would eat more, less, or the same number next month after the fish kill?

1 More
2 Less
3 Same
4 DK/NA

IF (ANSWER = 1) SKIPTO MORELESS
IF (ANSWER = 2) SKIPTO MORELESS
IF (ANSWER = 3) SKIPTO ENTER1
IF (ANSWER = 4) SKIPTO ENTER1

Q: AFTFISH2

Suppose that with the mandatory seafood inspection program the price of your portion of your average seafood meal goes up by $3, but the price of all other food stays the same. Compared to the [NUMBER] meals you ate last month, do you think that you would eat more, less, or the same number next month after the fish kill?

1 More
2 Less
3 Same
4 DK/NA

IF (ANSWER = 1) SKIPTO MORELESS
IF (ANSWER = 2) SKIPTO MORELESS
IF (ANSWER = 3) SKIPTO ENTER1

IF (ANSWER = 4) SKIPTO ENTER1

Q: AFTFISH3

Suppose that with the mandatory seafood inspection program the price of your portion of your average seafood meal goes up by $5, but the price of all other food stays the same. Compared to the [NUMBER] meals you ate last month, do you think that you would eat more, less, or the same number next month after the fish kill?

1 More
2 Less
3 Same
4 DK/NA

IF (ANSWER = 1) SKIPTO MORELESS
IF (ANSWER = 2) SKIPTO MORELESS
IF (ANSWER = 3) SKIPTO ENTER1
IF (ANSWER = 4) SKIPTO ENTER1

Q: AFTFISH4

Suppose that with the mandatory seafood inspection program the price of your portion of your average seafood meal goes up by $7, but the price of all other food stays the same. Compared to the [NUMBER] meals you ate last month, do you think that you would eat more, less, or the same number next month after the fish kill?

1 More
2 Less
3 Same
4 DK/NA

IF (ANSWER = 3) SKIPTO ENTER1
IF (ANSWER = 4) SKIPTO ENTER1

Q: MORELESS

About how many more/less seafood meals do you think you would eat next month?

Q: ENTER1

INTERVIEWER: ENTER 1 TO CONTINUE

IF (AFTFISH = 2) SKIPTO ELEC2
IF (AFTFISH = 3) SKIPTO ELEC3
IF (AFTFISH = 4) SKIPTO ELEC4

Q: ELEC1

Suppose that the proposed mandatory seafood inspection program is put to a vote in the November national election. If more than one-half of all people voted for it the Department of Commerce would put it into practice. If you knew the price of your portion of your average seafood meal would go up by $1 but the price of all other food stays the same, would you vote for or against it?

1 For
2 Against
3 DK/NA

IF (ANSWER = 1) SKIPTO SURE
IF (ANSWER = 2) SKIPTO SURE
IF (ANSWER = 3) SKIPTO VOTE

Q: ELEC2

Suppose that the proposed mandatory seafood inspection program is put to a vote in the November national election. If more than one-half of all people voted for it the Department of Commerce would put it into practice. If you knew the price of your portion of your average seafood meal would go up by $3 but the price of all other food stays the same, would you vote for or against it?

1 For
2 Against
3 DK/NA

IF (ANSWER = 1) SKIPTO SURE
IF (ANSWER = 2) SKIPTO SURE
IF (ANSWER = 3) SKIPTO VOTE

Q: ELEC3

Suppose that the proposed mandatory seafood inspection program is put to a vote in the November national election. If more than one-half of all people voted for it the Department of Commerce would put it into practice. If you knew the price of your portion of your average seafood meal would go up by $5 but the price of all other food stays the same, would you vote for or against it?

1 For
2 Against
3 DK/NA

IF (ANSWER = 1) SKIPTO SURE
IF (ANSWER = 2) SKIPTO SURE

IF (ANSWER = 3) SKIPTO VOTE

Q: ELEC4

Suppose that the proposed mandatory seafood inspection program is put to a vote in the November national election. If more than one-half of all people voted for it the Department of Commerce would put it into practice. If you knew the price of your portion of your average seafood meal would go up by $7 but the price of all other food stays the same, would you vote for or against it?

1 For
2 Against
3 DK/NA

IF (ANSWER = 3) SKIPTO VOTE

Q: SURE

Are you very sure, somewhat sure, not very sure, or not sure at all that you would vote for/against the proposal?

1 Very sure
2 Somewhat sure
3 Not very sure
4 Not sure at all
5 DK/NA

Q: VOTE

How likely is it that you will vote in the November national election? Are you ... [READ CATEGORIES]?

1 Very sure
2 Somewhat sure
3 Not very sure
4 Or not sure at all
5 DK/NA

Q: UNDERST

During this survey, we asked you many questions about how many seafood meals you would eat under hypothetical situations. Did you understand these questions ... [READ CATEGORIES]?

1 Very well
2 Somewhat well

3 Not very well
4 Or not at all
5 DK/NA

Q: HARD

Were these questions very hard, somewhat hard, somewhat easy, or very easy to answer?

1 Very hard
2 Somewhat hard
3 Somewhat easy
4 Very easy
5 DK/NA

Q: CERTAIN

How sure were you about your answers?  Were you ... [READ CATEGORIES]?

1 Very sure
2 Somewhat sure
3 Not very sure
4 Or not sure at all
5 DK/NA

Q: SUMMARY

That's all my questions at this time. Would you like a summary of the results of this survey?

1 Yes
2 No

IF (ANSWER = 2) SKIPTO THANKS

Q: INFO

The results will be mailed out to you in about a year. Just to verify your address, you live at...

1 Correct
2 Incorrect

if (answer = 1) skipto thanks

Q: NEWADD

What is your address?

SKIPTO THANKS

Q: MAIL

Okay, then we will gladly mail you another brochure. Is your address still … ?

1 Yes
2 No

if (answer = 1) skipto callback

Q: NEWADDR

Can I please have your address so we can send you the information?

Q: CALLBACK

Okay, then we will call you back in about a week or so to complete the survey.

Q: THANKS

Thanks for participating in this survey! Have a great day.

## Appendix E. Sample Weights

| County | State | Population | Sample | Percent of Population | Percent of Sample | Weight |
|---|---|---|---|---|---|---|
| District of Columbia | DC | 519,000 | 46 | 3.91 | 2.56 | 1.53 |
| Kent County | DE | 126,048 | 45 | 0.95 | 2.50 | 0.38 |
| New Castle County | DE | 487,182 | 141 | 3.67 | 7.85 | 0.47 |
| Sussex County | DE | 140,308 | 51 | 1.06 | 2.84 | 0.37 |
| Anne Arundel County | MD | 480,483 | 20 | 3.62 | 1.11 | 3.25 |
| Baltimore City | MD | 632,681 | 25 | 4.76 | 1.39 | 3.42 |
| Baltimore County | MD | 723,914 | 33 | 5.45 | 1.84 | 2.97 |
| Calvert County | MD | 73,748 | 6 | 0.55 | 0.33 | 1.66 |
| Caroline County | MD | 29,708 | 1 | 0.22 | 0.06 | 4.02 |
| Cecil County | MD | 84,238 | 7 | 0.63 | 0.39 | 1.63 |
| Charles County | MD | 120,946 | 5 | 0.91 | 0.28 | 3.27 |
| Dorchester County | MD | 29,709 | 2 | 0.22 | 0.11 | 2.01 |
| Harford County | MD | 217,908 | 13 | 1.64 | 0.72 | 2.27 |
| Howard County | MD | 243,112 | 12 | 1.83 | 0.67 | 2.74 |
| Kent County | MD | 19,089 | 2 | 0.14 | 0.11 | 1.29 |
| Montgomery County | MD | 852,174 | 39 | 6.41 | 2.17 | 2.95 |
| Prince George's County | MD | 781,781 | 37 | 5.88 | 2.06 | 2.86 |
| Queen Anne's County | MD | 40,688 | 3 | 0.31 | 0.17 | 1.83 |
| Somerset, Wicomico Counties | MD | 103,796 | 4 | 0.78 | 0.22 | 3.51 |
| St. Mary's County | MD | 88,758 | 8 | 0.67 | 0.45 | 1.50 |
| Talbot County | MD | 33,550 | 1 | 0.25 | 0.06 | 4.54 |
| Beaufort County | NC | 45,150 | 1 | 0.34 | 0.06 | 6.11 |
| Bertie County | NC | 20,392 | 1 | 0.15 | 0.06 | 2.76 |
| Bladen County | NC | 30,919 | 3 | 0.23 | 0.17 | 1.39 |
| Brunswick County | NC | 71,214 | 27 | 0.54 | 1.50 | 0.36 |
| Camden County | NC | 6,866 | 7 | 0.05 | 0.39 | 0.13 |
| Carteret County | NC | 60,031 | 23 | 0.45 | 1.28 | 0.35 |
| Chowan County | NC | 14,309 | 8 | 0.11 | 0.45 | 0.24 |
| Columbus County | NC | 52,946 | 23 | 0.40 | 1.28 | 0.31 |
| Craven County | NC | 89,391 | 35 | 0.67 | 1.95 | 0.35 |
| Cumberland County | NC | 283,650 | 94 | 2.13 | 5.23 | 0.41 |
| Currituck County | NC | 18,305 | 7 | 0.14 | 0.39 | 0.35 |
| Dare County | NC | 29,640 | 11 | 0.22 | 0.61 | 0.36 |
| Duplin County | NC | 43,379 | 18 | 0.33 | 1.00 | 0.33 |
| Edgecombe County | NC | 54,659 | 27 | 0.41 | 1.50 | 0.27 |
| Franklin County | NC | 45,612 | 6 | 0.34 | 0.33 | 1.03 |
| Gates County | NC | 10,180 | 3 | 0.08 | 0.17 | 0.46 |
| Granville County | NC | 44,546 | 2 | 0.34 | 0.11 | 3.01 |
| Greene County | NC | 18,537 | 11 | 0.14 | 0.61 | 0.23 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Halifax County | NC | 55,832 | 13 | 0.42 | 0.72 | 0.58 |
| Harnett County | NC | 84,501 | 32 | 0.64 | 1.78 | 0.36 |
| Hertford County | NC | 21,937 | 6 | 0.17 | 0.33 | 0.49 |
| Hoke County | NC | 31,324 | 14 | 0.24 | 0.78 | 0.30 |
| Johnston County | NC | 110,850 | 46 | 0.83 | 2.56 | 0.33 |
| Jones County | NC | 9,320 | 2 | 0.07 | 0.11 | 0.63 |
| Lenoir County | NC | 58,842 | 26 | 0.44 | 1.45 | 0.31 |
| Martin County | NC | 26,133 | 8 | 0.20 | 0.45 | 0.44 |
| Nash County | NC | 92,369 | 34 | 0.70 | 1.89 | 0.37 |
| New Hanover County | NC | 150,895 | 69 | 1.14 | 3.84 | 0.30 |
| Northampton County | NC | 21,234 | 7 | 0.16 | 0.39 | 0.41 |
| Onslow County | NC | 142,480 | 30 | 1.07 | 1.67 | 0.64 |
| Orange County | NC | 111,533 | 3 | 0.84 | 0.17 | 5.03 |
| Pamlico County | NC | 12,314 | 12 | 0.09 | 0.67 | 0.14 |
| Pasquotank County | NC | 35,629 | 13 | 0.27 | 0.72 | 0.37 |
| Pender County | NC | 40,293 | 25 | 0.30 | 1.39 | 0.22 |
| Perquimans County | NC | 11,294 | 5 | 0.08 | 0.28 | 0.31 |
| Pitt County | NC | 127,960 | 66 | 0.96 | 3.67 | 0.26 |
| Robeson County | NC | 116,597 | 39 | 0.88 | 2.17 | 0.40 |
| Sampson County | NC | 52,812 | 24 | 0.40 | 1.34 | 0.30 |
| Scotland County | NC | 35,882 | 16 | 0.27 | 0.89 | 0.30 |
| Wake County | NC | 586,940 | 206 | 4.42 | 11.46 | 0.39 |
| Washington County | NC | 13,443 | 5 | 0.10 | 0.28 | 0.36 |
| Wayne County | NC | 111,711 | 41 | 0.84 | 2.28 | 0.37 |
| Wilson County | NC | 68,801 | 26 | 0.52 | 1.45 | 0.36 |
| Accomack County | VA | 32,121 | 4 | 0.24 | 0.22 | 1.09 |
| Alexandria City | VA | 117,390 | 4 | 0.88 | 0.22 | 3.97 |
| Arlington County | VA | 174,848 | 6 | 1.32 | 0.33 | 3.94 |
| Chesapeake City | VA | 202,759 | 13 | 1.53 | 0.72 | 2.11 |
| Chesterfield County | VA | 253,365 | 14 | 1.91 | 0.78 | 2.45 |
| Fairfax County/City | VA | 966,414 | 51 | 7.27 | 2.84 | 2.56 |
| Fauquier County | VA | 55,206 | 1 | 0.42 | 0.06 | 7.47 |
| Gloucester County | VA | 35,463 | 4 | 0.27 | 0.22 | 1.20 |
| Hampton City | VA | 137,193 | 14 | 1.03 | 0.78 | 1.33 |
| Henrico County | VA | 244,652 | 19 | 1.84 | 1.06 | 1.74 |
| Isle of Wight County | VA | 29,632 | 6 | 0.22 | 0.33 | 0.67 |
| James City County | VA | 45,945 | 2 | 0.35 | 0.11 | 3.11 |
| King George County | VA | 17,681 | 2 | 0.13 | 0.11 | 1.20 |
| Mathews County | VA | 9,255 | 2 | 0.07 | 0.11 | 0.63 |
| Middlesex County | VA | 9,771 | 1 | 0.07 | 0.06 | 1.32 |
| New Kent County | VA | 13,218 | 1 | 0.10 | 0.06 | 1.79 |
| Newport News City | VA | 179,138 | 6 | 1.35 | 0.33 | 4.04 |
| Norfolk City | VA | 225,875 | 7 | 1.70 | 0.39 | 4.36 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Orange County | VA | 25,759 | 1 | 0.19 | 0.06 | 3.48 |
| Petersburg City | VA | 34,398 | 1 | 0.26 | 0.06 | 4.65 |
| Poquoson City | VA | 11,571 | 1 | 0.09 | 0.06 | 1.56 |
| Portsmouth City | VA | 98,305 | 6 | 0.74 | 0.33 | 2.22 |
| Prince George County | VA | 28,812 | 1 | 0.22 | 0.06 | 3.90 |
| Prince William County | VA | 270,841 | 8 | 2.04 | 0.45 | 4.58 |
| Richmond County | VA | 8,745 | 3 | 0.07 | 0.17 | 0.39 |
| Richmond City | VA | 189,700 | 3 | 1.43 | 0.17 | 8.55 |
| Southampton County | VA | 17,678 | 3 | 0.13 | 0.17 | 0.80 |
| Spotsylvania, Stafford Counties | VA | 180,521 | 8 | 1.36 | 0.45 | 3.05 |
| Suffolk City | VA | 64,805 | 3 | 0.49 | 0.17 | 2.92 |
| Sussex County | VA | 12,345 | 1 | 0.09 | 0.06 | 1.67 |
| Virginia Beach City | VA | 433,461 | 18 | 3.26 | 1.00 | 3.26 |
| York County | VA | 58,433 | 7 | 0.44 | 0.39 | 1.13 |